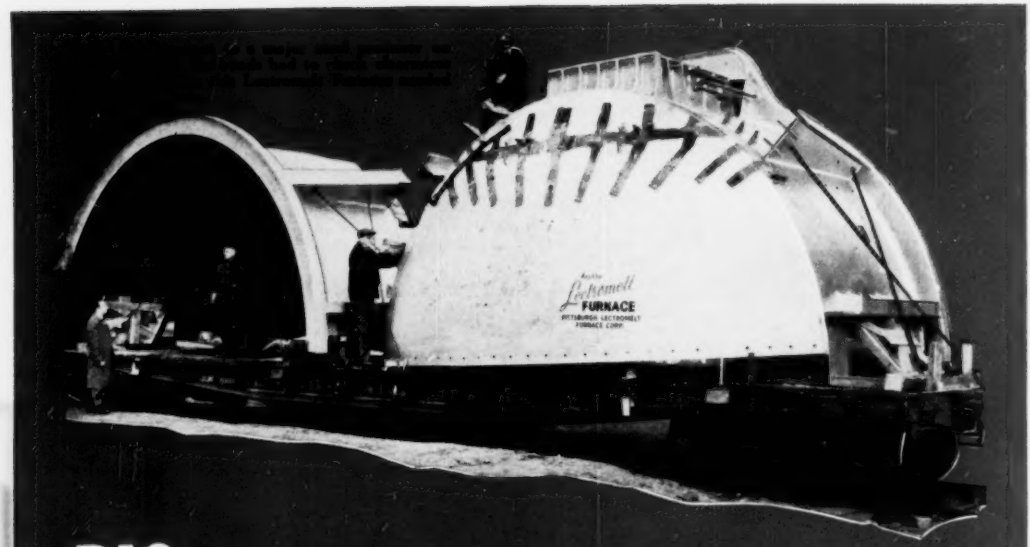
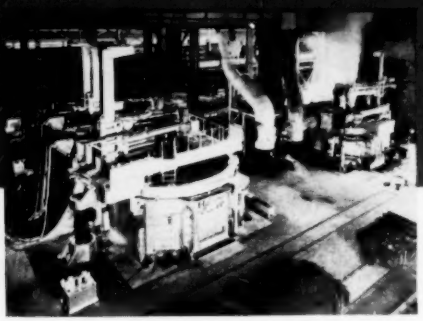
American Foundryman

THE FOUNDRYMEN'S OWN MAGAZINE

SEPTEMBER
1950



BIG ...but this 20-foot diameter Lectromelt Furnace got to work FAST



At the left, this new Size HT (20-foot diameter) Lectromelt Furnace is now on the job. At the right, a two-year-old Size KT (17-foot diameter) Lectromelt Furnace.

Completely assembled and mechanically tested on our erection floor at Pittsburgh, this Lectromelt Furnace went together fast at the customer's plant. Final fitting operations had been done here—cheaper and better for the buyer.

Buyers sometimes wonder why we insist on assembling these big Lectromelt Furnaces at the factory, then tearing them down and shipping them in sections, only to re-erect them in their final position. This costs us money, it's true, but it saves the purchaser time and money on the over-all installation.

This pretesting is like many of the "firsts" in electric arc furnace design and construction credited to Moore, inventor of the Rapid Lectromelt Furnace. Your furnace gets into production faster and easier.

Whether your problem is melting, refining, smelting or reduction, let our engineers help you select a furnace for the job. Write Pittsburgh Lectromelt Furnace Corporation, 316 32nd St., Pittsburgh 30, Pa.

Manufactured in . . . CANADA: Lectromelt Furnaces of Canada, Ltd., Toronto 2 . . . ENGLAND: Birlec, Ltd., Birmingham . . . SWEDEN: Birlec Elektkougnar A/B, Stockholm . . . Australia: Birlec, Ltd., Sydney . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa.

WHEN YOU MELT... MOORE RAPID *Lectromelt*

SIGNS of the trend...

Here's an 18-second summary on why most foundries use Crown Hill Seacoal Facing for venting molds.

The high volatile content (see Bureau of Mines figures) of Crown Hill means quick flash. Since the fusion point of the small ash residue is 2980° F., molten iron cannot fuse it, and low sulphur content eliminates hard spots. In short, peeling is easy and cleaning costs *come down.* Try Crown Hill, choice of most foundrymen.

FIGURES FROM BUREAU OF MINES
DEPT. OF INTERIOR OF THE U. S.

(Moisture Free)

PROXIMATE ANALYSIS

Volatile Matter (V.C.M.)	38.9%
Fixed Carbon	57.4%
Ash	3.7%
	100.0%

ULTIMATE ANALYSIS

Hydrogen	5.4%
Carbon	82.0%
Nitrogen	1.6%
Oxygen	6.6%
Sulphur	.7%
Ash	3.7%
	100.0%

Fusion Point of Ash . . . 2980° F

THE FEDERAL FOUNDRY SUPPLY COMPANY

Seacoal Plant
CROWN HILL, W. VA. • CHICAGO • DETROIT • MILWAUKEE • RICHMOND, VA. Mines
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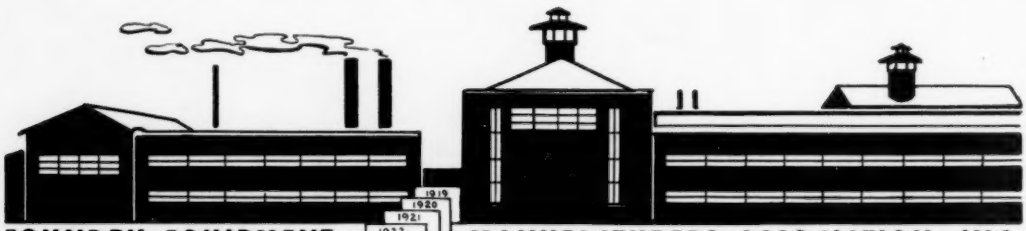
Commerce Station Box 71, Minneapolis 15, Minn.

4600 East 71st Street
Cleveland 5, Ohio



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What F. E. M. A. does for the Foundry Industry

- Fosters member co-operation
- Improves trade relations
- Promotes industry recognition
- Stimulates foundry research
- Disseminates progress reports
- Co-operates with allied organizations
- Compiles trade information
- Stimulates better foundry equipment

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National Metal Abrasive Company
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Parsons Engineering Corporation
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Pittsburgh Crushed Steel Company
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SEPTEMBER, 1950

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VOLUME XVIII, NUMBER 3

American Foundryman

September, 1950

Official publication of American Foundrymen's Society

The American Foundrymen's Society is not responsible for statements or opinions advanced by authors of papers in its publication.

Pouring a dipper head casting for earth moving equipment at Minneapolis Electric Steel Castings Co., Minneapolis, from a 4000-lb teapot-type geared ladle. The 760-lb casting is made in a skin dried mold with cavity entirely in the drag. Risers are contained in the largest core shown; mold is clamped by a system of rails and bars.

Published monthly by the American Foundrymen's Society, Inc., 616 S. Michigan Ave., Chicago 5. Subscription price in the U. S., Canada and Mexico, $3.00 per year; elsewhere, $6.00. Single copies, 50c. Entered as second class matter July 22, 1938, under Act of March 3, 1879, at the Post Office, Chicago, Illinois. EASTERN REPRESENTATIVE—Warren Thomson Mavers Co., 130 East 61st St., New York. CENTRAL REPRESENTATIVE—Frank J. Enright, 16718 Kenyon Road, Cleveland. MIDWESTERN REPRESENTATIVE—L. F. McClure & Associates, 814 N. Tower Court, Chicago.

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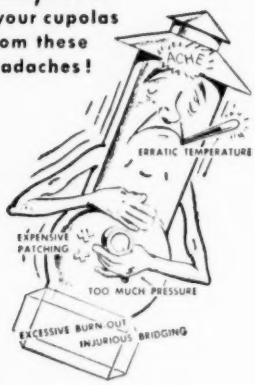
Let *Cupoline* free your cupolas from these headaches!



Cupoline leads to slower burn-out, which means a more uniform operation, especially a more uniform melting rate. Variations caused by the human equation are reduced to a new low. Being monolithic, Cupoline eliminates the shortcomings of linings with joints. Its low clay content requires minimum water. This virtue and its high refractory properties avoid the serious hazards of spalling and bridging. In connection with the Bondact process, Cupoline lends itself admirably to contour patching, which saves 25% in material. Linings last much longer if patched with Cupoline; in fact, may be maintained to eliminate reline jobs.

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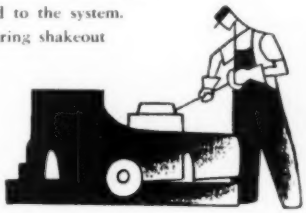
THE IDEAL FOUNDRY SAND CONDITIONER

Sand-Mex is an economical, specially prepared graphite product which, when mixed with foundry sand, increases the flowability and refractoriness of the sand. Sand-Mex is super-refractory, non-gaseous and chemically inert. By coating each grain, Sand-Mex increases stability of the sand and reduces friction between the sand grains. It insulates the sand from chemical or physical contact with the metal, and less expansion and contraction of the sand occurs when the metal is poured into the mold — this means sharper pattern impressions, resulting in castings truer to patterns.

Application: Sand-Mex is easily and economically applied to molding sands at the rate of 40 pounds per ton of sand. Sand-Mex remains permanently in the sand and further additions are made only when new or untreated sand is added to the system. Sand-Mex should be thoroughly mixed, preferably mulled with the sand, in order to obtain best results.

Pouring: Sand-Mex makes molding sand easier to work, gives it greater stability by reducing expansion and contraction in pouring. It prevents chemical reaction between iron oxide and sand, thus helping to eliminate rat-tails, scabs and other defects . . . Sand treated with Sand-Mex, flows more easily and does not hang or bridge in the hoppers — permits all the system sand to be used for molding.

Shakeout: Sand-Mex increases the flowability and collapsibility of sand. This reduces shakeout time to a minimum because the sand has less retained strength, is not so strongly fused, and is more easily broken down. Also, more sand is returned to the system. Damage to casting during shakeout is minimized.



Finishing: Sand-Mex results in cleaner castings with better color and finish. Sand-Mex prevents sand from clinging to the casting — makes cleaning easier. Less finishing time, better castings . . . only two more reasons why Sand-Mex is ideal for foundry use.

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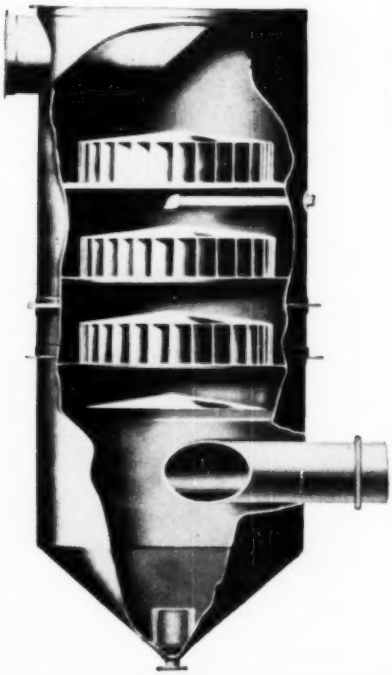

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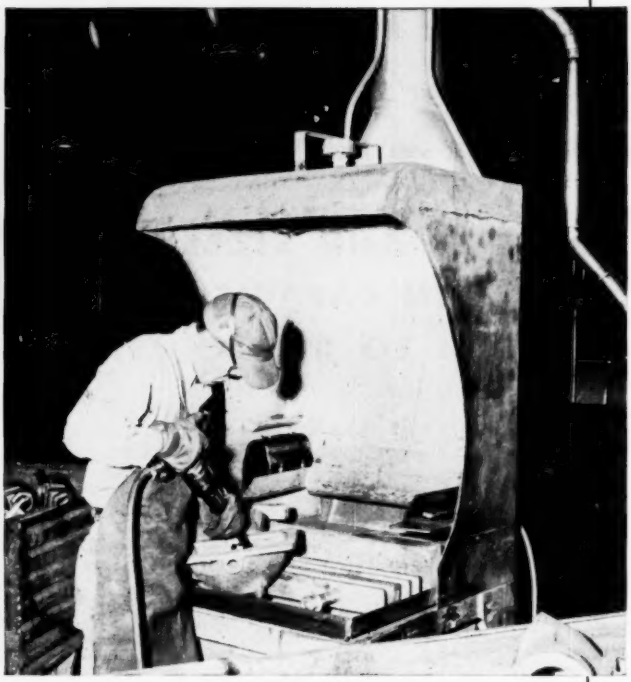

THEY don't "let the chips (and dust) fall where they may" in this foundry. Pictured here is a modern down-draft chipping booth which is served by an AAF Type D Roto-Clone.* Chips and dust are drawn off as fast as they are generated. Worker comfort is vastly improved and he has a clear view of the job at all times.

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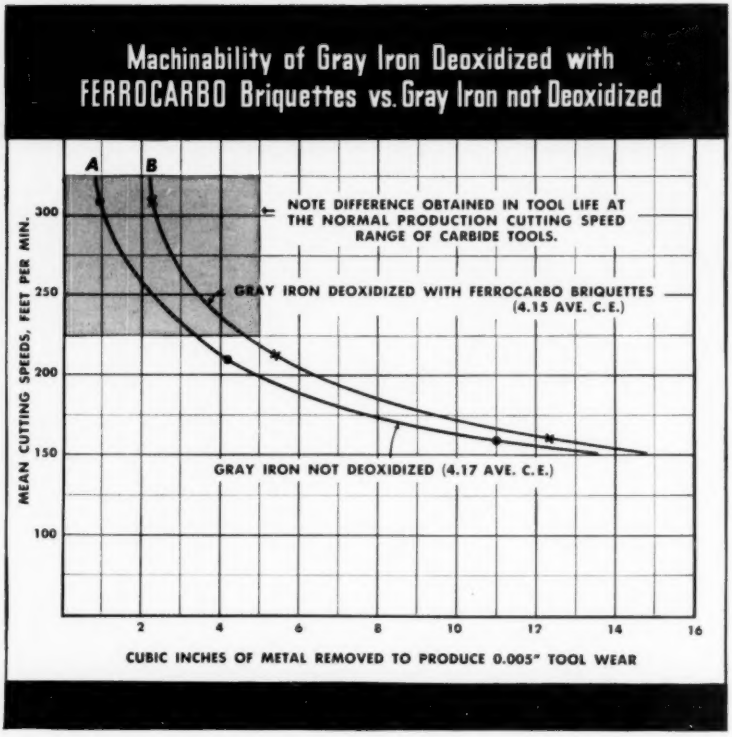

FERROCARBO silicon carbide Briquettes, when added to the cupola charge, offer many advantages. The chart illustrates the result of an actual test and shows their effect on machining the "as cast" surface, plus a shallow cut into the underlying metal. The distance from A to B is the *extra* margin of tool life obtained when machining castings treated with FERROCARBO Briquettes. Tools employed in test were single point cemented carbide.

Increased tool life in machining castings produced by adding FERROCARBO Briquettes in the cupola charge results because: 1. Surface chill is sharply reduced. 2. Easily machined fine grained iron is produced with a random dispersion of flake graphite. 3. Cutting tools encounter fewer segregated hard areas, because of the more uniformly machinable gray iron structure.

This added tool life is an important economy. Tool life, in proportion to metal removed, increases as machining speeds increase...thereby leading to high speed economical production of machined cast iron parts.

FERROCARBO Briquettes can help you produce better quality, easily machinable and more salable castings. Our distributors are well qualified to explain in detail how these advantages can be obtained in your operation. The Carborundum Company, Bonded Products and Abrasive Grain Division, Niagara Falls, N. Y.

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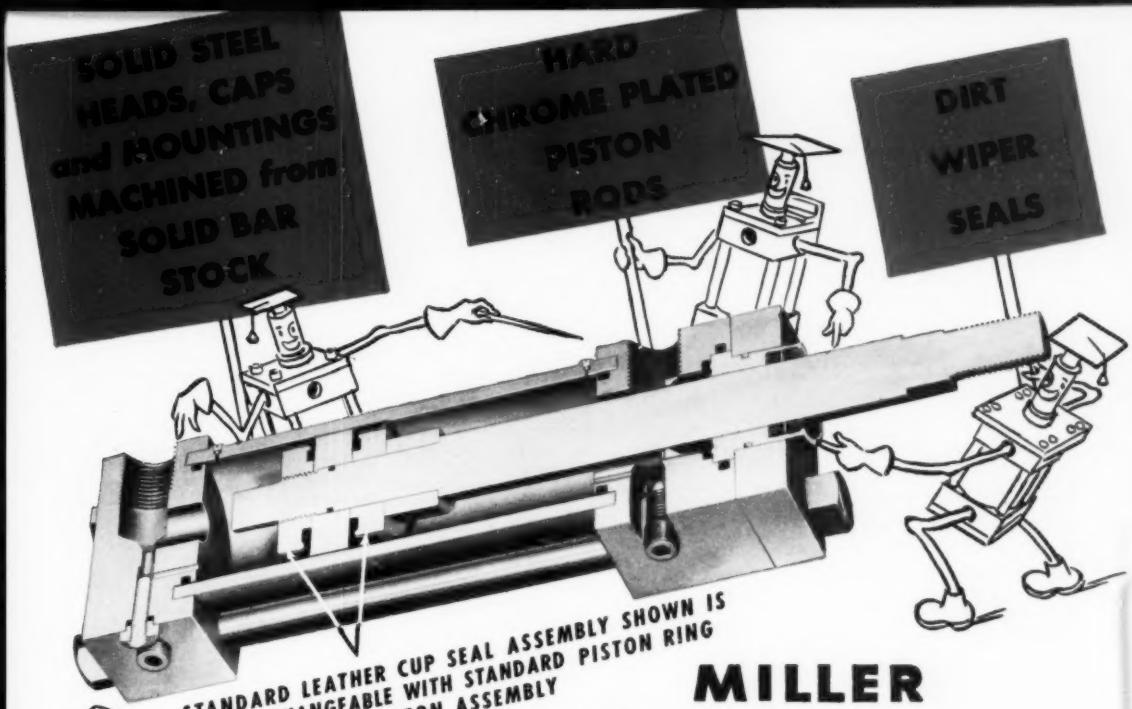

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Meet J. I. C. HYDRAULIC STANDARDS

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The Miller "Patented" Hydraulic Piston Rod Seal which has no manual adjustment and is automatically self-adjusting and wear-compensating to give life-long leakproof service without ever requiring any manual adjustment whatsoever . . . far surpasses the requirement of J. I. C. Standard H6.2.5 which specifies "Stuffing boxes for automatic packing shall be so designed as to prevent adjustment beyond the functional limits of the packing"

Write for illustrated cylinder bulletins A-105 and H-104

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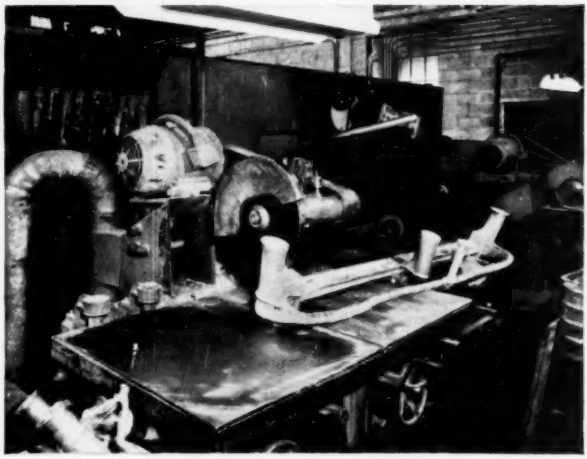
MANHATTAN 20" x 3/16" Grade 463XX on FOX Swing Cut-Off Machine

MANHATTAN 16" x 1/8" Grade 463XX on TABOR Foundry Cut-Off Machine



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Come and see these wheels in operation at the Metal Show in Chicago, October 23-27. Booth 2130. Demonstrations with Tabor machine and also portables.

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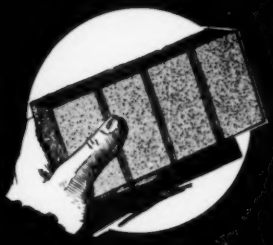

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REDUCE CASTING REJECTS

At a cost of only a fraction of a cent per average size casting, you can guard against costly casting rejects by using a little Famous Cornell Cupola Flux regularly in your iron charges. In many cases the dollar saving has been amazing. By using Famous Cornell Cupola Flux, you keep your molten iron free from impurities, and freer flowing. Sulphur is greatly reduced and slag is kept fluid. You pour castings that are sounder and cleaner, easier to machine. You keep your cupolas cleaner and increase their efficiency. You protect the life of cupola lining and reduce maintenance labor to practically nothing.

SCORED BRICK FORM makes using easy, cuts labor to the minimum. You just take Famous Cornell Cupola Flux from container and toss it into cupola with each ton charge of iron, or break off one to three briquettes (quarter sections) for smaller charges, as per instructions.

Write for Bulletin No. 46-B

MALLEABLE FOUNDRIES with Cupola Operation are not only giving their castings a better start with clean metal but are enjoying big savings in cupola maintenance. Famous Cornell Cupola Flux keeps cupolas cleaner. It reduces bridging over to a great extent, insures cleaner drops.

Famous **CORNELL ALUMINUM FLUX**

CLEANSES MOLTEN ALUMINUM so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive Formula greatly reduces obnoxious gases, improves working conditions. Dross contains no metal after this flux is used.

***The* CLEVELAND FLUX Co.**

1026-1040 MAIN AVENUE, N. W.
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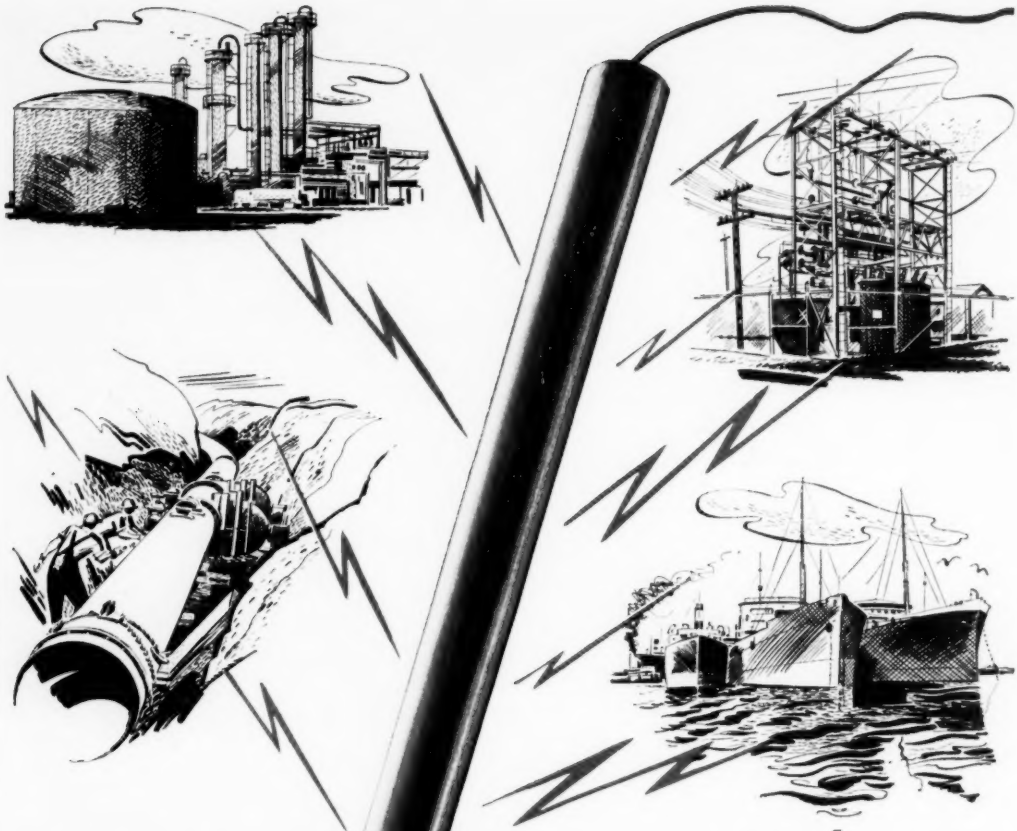
Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze, Aluminum Flux Since 1918

FAMOUS FLUXES
Trade Mark Registered

Famous **CORNELL BRASS FLUX**

CLEANSES MOLTEN BRASS even when dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves you considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining life and reduces maintenance.



PROTECT METAL STRUCTURES POSITIVELY UNDER ALL CONDITIONS!

"NATIONAL" GROUND ANODES

● Regardless of what the job is . . . how corrosive the environment — whether wet or dry, hot or cold — you can depend upon "National" ground anodes to provide efficient, positive protection against underground and underwater corrosion.

"National" ground anodes have proved themselves in 20 years of successful operation in many different parts of the country. They outlast other materials by a wide margin. They do not have to be dug up and replaced every couple of years. Because they use a controllable current source, it is simple and economical to adjust their protective output to match exactly the requirements of any installation.

For complete details on "National" ground anodes, write to National Carbon Division, Union Carbide and Carbon Corporation, Dept. AF.

The terms "National" and "Eveready" are registered trade-marks of

NATIONAL CARBON DIVISION
UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
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MORE THAN DOUBLE THE USABLE LIGHT!

The biggest news since the invention of flashlights—the brand new leakproof "Eveready" No. 1050 flashlight battery—gives more than double the usable brilliant white light for critical uses than any other flashlight battery we ever made.

NO METAL CAN TO LEAK OR CORRODE

NISILOY

A POWERFUL, POSITIVE INOCULANT

Cuts Final Cost of Gray Iron Castings

by improving

MACHINABILITY, GRAIN STRUCTURE, UNIFORMITY

BENEFITS TO FOUNDRYMEN

Reduces Rejects—Used for structure control of cast iron, Nisiloy helps your foundry meet daily schedules for uniform lots of machinable gray iron castings.

Promotes Sound Castings—Diffusing rapidly throughout the melt, Nisiloy promotes a dense, close-grained product.

Curbs Breakage—Even where section thickness varies sharply, Nisiloy serves to eliminate chilled edges and surfaces, thus affording a tougher cast iron that resists breakage in shop handling.

No Scrap Problem—Containing only elements that dissolve freely in iron, Nisiloy permits remelting sprues and gates in any successive melt without risk of adding chill-forming elements.

Fewer Base Mixtures—Often a single base mixture may be used in the cupola to which Nisiloy is added in the ladle, with the consequent flexibility of pouring off thin or thick sectioned castings as desired.

For full information about this nickel-silicon alloy, one of the most useful products ever offered for improving machinability and structure of gray iron castings, fill in and mail the coupon below.

BENEFITS TO CASTING USERS

Excellent Machining Qualities—The dense, gray, machinable structure secured with Nisiloy reduces machining time, tool wear, rejects and costs.

Increased Wear-Resistance—The formation and distribution of finely divided random flake graphite accomplished with Nisiloy assures highly improved resistance to wear.

Improved Toughness—Nisiloy acts to eliminate hard, chilled areas . . . thus, the casting is thoroughly machinable in thin and thick sections alike and less sensitive to breakage in machining operations and general service.

Dependable Pressure-Tightness—The sound, homogeneous structure attained by inoculating with Nisiloy results in dense cast iron that provides substantially improved pressure-tightness.

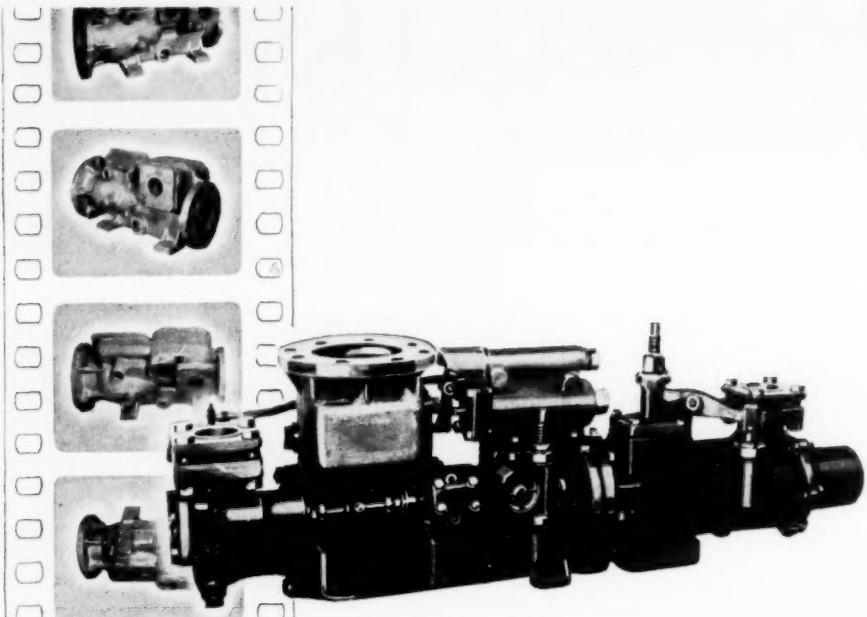
EMBLEM OF INCO SERVICE

The International Nickel Company, Inc.
Dept. AF, 67 Wall Street, New York 5, N. Y.

Please send me your booklet entitled:
"NISILOY" for GRAY IRON CASTINGS

Name.....Title.....
Company.....
Address.....
City.....State.....

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.



Exhaust Steam Injector Body
Courtesy Combustion Engineering-Superheater Inc.

to be sure COMBUSTION-SUPERHEATER uses **FEDERATED** BRONZE INGOT

When a difficult bronze casting problem faced Combustion Engineering-Superheater Inc., they turned to Federated Metals and the Christensen and Olsen Foundry in Chicago.

C & O and Federated solved the problem. The castings... parts of an Exhaust Steam Injector Body which must be pressure tight and virtually perfect... are made by C & O. Federated copper-base alloys are used because metal of consistent quality is demanded.

Federated metals and Federated service are at your command, too, whenever you have a foundry problem.

See Federated first for any non-ferrous alloy... aluminum, magnesium and copper-base foundry metals; solders; bearing metals; and fabricated lead products.

Federated Metals Division

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AMERICAN SMELTING AND REFINING COMPANY • 120 BROADWAY, NEW YORK 5, N. Y.

You Score on All Four...

WHEN YOU USE KRAUSE CEREAL BINDERS

1 GET MORE GREEN STRENGTH

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Yes — the qualities you need and want are yours in Krause's Cereal Binders—TRUSCOR (light weight) and AMERIKOR (heavy weight).

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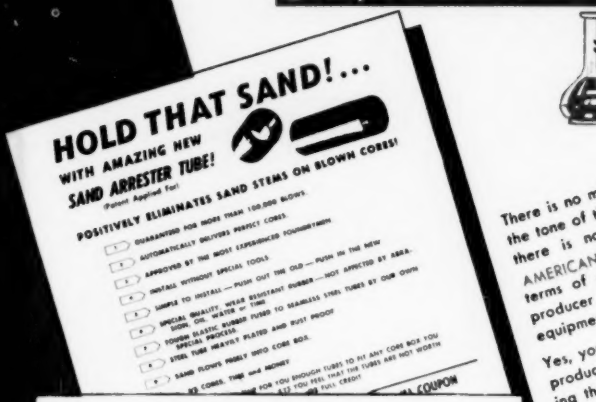
American Foundryman

Compounded to Stand the Test



HOLD THAT SAND!...

WITH AMAZING NEW SAND ARRESTER TUBE!

(Patent Applied for)

POSITIVELY ELIMINATES SAND STEMS ON BLOWN CORES!

- GUARANTEED FOR MORE THAN 100,000 BLOWS.
- AUTOMATICALLY DELIVERS PERFECT CORES
- APPROVED BY THE MOST EXPERIENCED FOUNDRYMEN
- INSTALL WITHOUT SPECIAL TOOLS
- INSTALL — PUSH OUT THE OLD — PUSH IN THE NEW
- SIMPLE TO INSTALL
- SPECIAL QUALITY, HEAT RESISTANT RUBBER — NOT AFFECTED BY AREA, SHORN OIL, WATER or TIME
- TOUGH PLASTIC HEAD FUSED TO SEAMLESS STEEL TUBES BY OUR OWN SPECIAL PROCESS
- STEEL TUBE HEAVILY PLATED AND RUST PROOF
- SAND FLOWS FREELY INTO CORE BOX.
- SAND FLOWS FREELY INTO CORE BOX.

NO CORES, TIME and MONEY

...ER FOR YOU SMOOTH TUBES TO FIT ANY CORE BOX YOU ...ED. IF YOU FEEL THAT THE TUBES ARE NOT WORTH ...ED YOU CREDIT

...L COUPON

MARTIN

ENGINEERING COMPANY

...EWANEE 9/13/49 ILLINOIS

Mr. John D. Murray, Adv. Mgr.
American Foundryman
222 W. Adams St.
Chicago 6, Ill.

Dear Mr. Murray:

Enclosed is a schedule of advertisements that our company has decided upon for American Foundryman. Frankly, we are very pleased with results to date. Coupons have been coming in consistently, and we are checking these carefully to gauge the market.

Of those received so far, American Foundryman has a distinct edge in the number of inquiries, with the advantage of an average ratio of 2 to 1 in sales over other publications.

It is on this record that we have decided to expand the schedule, per the enclosed.

Very truly yours,

MARTIN ENGINEERING CONSULT

E. F. Peterson

E. F. Peterson, Pres.

EFP/...

There is no mistaking results and, from the tone of the letter reproduced here, there is no mistaking the fact that AMERICAN FOUNDRYMAN, judged in terms of results, is the leading sales producer for the marketing of foundry equipment and supplies.

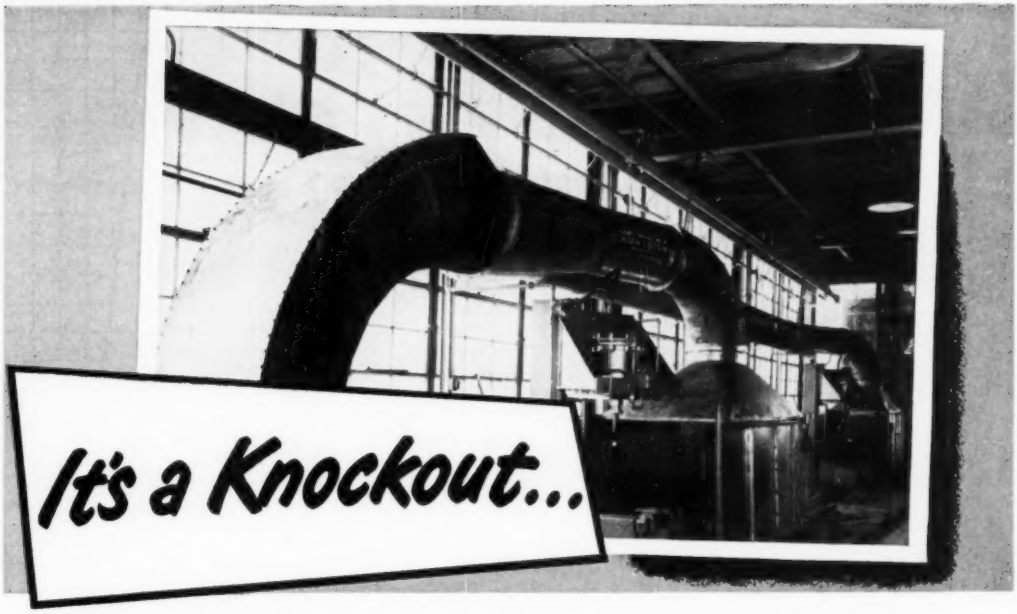
Yes, you've seen this advertisement reproduced in the pages of media reaching the foundry field, and you will be interested to know that the advertiser has kept a close tally on returns. The outcome was conclusive . . . AMERICAN FOUNDRYMAN **outpulled other magazines 2 to 1** in completed sales! This can mean only one thing—AMERICAN FOUNDRYMAN is the magazine that manufacturers can depend upon for results . . . **the kind of results that mean profitable advertising.**

AMERICAN FOUNDRYMAN can "pull" equally as many returns for those firms whose products are suited for use by the thousands of subscriber-members who regularly look to "**The Foundrymen's Own Magazine**" as a reliable source of information on the development and production of cast metals.

If AMERICAN FOUNDRYMAN isn't already scheduled for your 1949-50 sales program, it is only **good business** to do so immediately—it costs less than 2c per prospect to reach the readers of AMERICAN FOUNDRYMAN each month with an ad similar to the one reproduced above. Send for full details today!

...an Foundryman

616 S. Michigan Ave.,
Chicago 5, Ill.



THIS KIRK AND BLUM DUST CONTROL SYSTEM ON SPRUE-BREAKING AND CORE KNOCK-OUT OPERATIONS

● In foundry operations . . . wherever you'd expect to find dust, smoke and fumes and *don't* . . . there you'll likely find a KIRK & BLUM installation.

In the photo shown above, for example, a dust control system fabricated and installed by Liberty Engineering, Division of KIRK & BLUM virtually eliminates dust. Of particular interest is the "flat-back" elbow. The curved plate shown is easily replaced or may be lined with abrasion-resistant material to meet severe conditions.

The photograph below shows the molding line, hoppers and supports which were also fabricated and installed by the Liberty Engineering Division. Other KIRK & BLUM systems are found in this same well known manufacturer's plant.

Whatever your foundry dust, fume or smoke problem . . . sand handling, pouring station ventilation . . . mold cooling, shakeouts, grinding and snagging or others . . . KIRK & BLUM Engineers have the experience needed to offer the logical solution, for truly efficient dust control.

Fabricated and Installed by Liberty Engineering Div.
The Kirk & Blum Mfg. Co., Indianapolis, Ind.
For detailed information and literature write
The Kirk & Blum Mfg. Co.
2876 Spring Grove Ave. Cincinnati 25, Ohio
FOR CLEAN AIR . . . THE INVISIBLE TOOL
KIRK AND BLUM
DUST CONTROL SYSTEMS

reduced losses

increased production

smoother castings

Ephrata Manufacturing Company
Quality Gray Iron Castings
Machine Work
Ephrata, Pa.

July 11, 1950

National Engineering Co.
549 West Washington Blvd.
Chicago 6, Illinois

attention: Mr. W. G. Pardonner

Gentlemen:

Referring to your letter of June 29 with reference to our Simpson Porto-Muller purchased from you some time ago, wish to advise that we are entirely satisfied with the performance of this equipment.

We are pleased to state that we have been able to reduce our losses on certain castings with the sand prepared by this machine and at the same time increased our production as well as produced smoother castings.

Should we have any problem in connection with this machine, you may be sure that we will contact Mr. Troy on same.

Yours very truly,

EPHRATA MANUFACTURING COMPANY

President

WMB/mgh

...thanks to the SIMPSON *Porto-Muller*

Here is another progressive foundryman that is taking advantage of the time and money-saving features offered with the SIMPSON *Porto-Muller.*

Recently introduced, there are now over one hundred *Porto-Mullers* in service, bringing a new conception of portability, together with the *true* Simpson mulling method.

For the full story on this newest National development, be sure to write for your copy of BULLETIN 492 today.

SIMPSON
Intensive
MIXERS

NATIONAL *Engineering Company*

600 Machinery Hall Bldg. • Chicago 6, Illinois

Manufacturers and Selling Agents for Continental European Countries—The George Fischer Steel & Iron Works, Schaffhausen, Switzerland. For the British Possessions, Excluding Canada and Australia—August's Limited, Halifax, England. For Canada—Dominion Engineering Co., Ltd., Montreal, Canada. For Australia and New Zealand—Gibson, Battle & Co., Pty., Ltd., Sydney, Australia

HOW GATES AND RISERS SELL CASTINGS

GATING AND RISERING of castings is one of the most discussed and least standardized phases of foundry technology. In the great trend toward control and standardization which has occurred in the foundry industry, particularly during the past 50 years, gating and risering have not kept pace with metallurgy, melting, sand control, and some other aspects of castings production. Failure to do so accounts in part for the reluctance of some engineers and designers to make greater use of castings when production factors, properties, and unusual shape indicate that castings are ideal for the application.

Engineers who swear by their slide rules and decimal points but who are not familiar with foundry problems cannot understand why all foundrymen don't gate and riser a given casting in the same way. Why, they say, can't the foundry superintendent or the molding foreman specify shapes, dimensions, number, and locations for risers, sprues, runners, and in-gates which assure good castings from the start to the finish of a run.

Most foundrymen agree on how gates and risers are supposed to function but there is considerable difference of opinion as to details. Often, more than one system of gates and risers—all other factors remaining essentially the same—will produce sound castings. In each of several systems the gates will supply a smooth flow of clean metal at a proper rate; will not produce hot spots, cut, or wash; and will not seriously hinder the contraction of the casting. The risers will provide a reservoir of molten metal to feed the interior of the castings while progressive solidification occurs in approved fashion. Together with the gates, the risers will not contain so much metal that yield will be too low, and in the cleaning room removal is easy with a minimum of material left for grinding.

This apparent lack of precision has made some users of castings turn to other metal parts merely because the method of production seems more precise. Overlooked is the fact that it is the usability of the product and not the method of production that counts. Castings still provide the shortest route from raw material to finished product, notwithstanding the fact that gates and risers are chosen on the basis of experience rather than taken off a chart in a handbook.

Through the years a number of attempts have been made to standardize gates and risers—to reduce them to a formula. Important steps have been taken toward standardization and a few formulas which have been used with some degree of success have been reported in the literature and in technical talks. One significant move toward organization information is the recording by sketch or photograph of successful gating and risering systems so that results can be duplicated on future runs of castings using the same pattern. An example is reported on page 56 of this issue of AMERICAN FOUNDRYMAN.

Foundries interested in a scientific approach to gating and risering might well follow the example of one outstanding production-jobbing shop which is testing all gating formulas reported in the literature. On the basis of actual tests on comparatively long runs of castings, this foundry is selecting those most successful and expects eventually to develop a simple approach to gating. Using a formula reported in A.F.S. TRANSACTIONS without modification, this foundry had less than one per cent scrap in 500 castings.

Fundamental investigations in gating and risering, results of which will be correlated with commercial practice, are being carried on under the auspices of A.F.S. through two of its research committees. Studies of gating are entering their third year at Battelle Memorial Institute under the direction of the Aluminum and Magnesium Research Committee. Under way since the first of the year at Massachusetts Institute of Technology is a study of risering of gray iron castings under the guidance of the Gray Iron Research Committee. Because both of these investigations are developing along fundamental lines, much of the new information created will be applicable to all casting alloys.

Reports on the gating project appear in the form of the popular A.F.S. film *"Fluid Flow in Transparent Molds"* and a detailed report in last year's TRANSACTIONS. Soon to be released is a color-sound movie on the second phase of the research; second report will appear in TRANSACTIONS for 1950.

First information reported out of the risering research is the booklet *"Risering of Gray Iron Castings,"* a combined correlated abstract with illustrations and bibliography.

As a result of the various studies in gating and risering conducted by the Society and by individuals, decisions on how best to get molten metal into the mold cavity and how to make the soundest possible casting should come easier, faster, and should be more precise. And users or potential users of castings who question their worth because a foundryman chooses his gates and risers on the basis of hard won experience rather than from a formula or table, will have a new appreciation for the foundry industry and its products.

—*Editor.*

BOARD OK'S PLAN for PERMANENT SOCIETY HOME

1896

GREEN LIGHT for the plan to acquire a permanent headquarters building for the A.F.S. National Office was given July 28 when the Board of Directors unanimously approved the proposal. Aim of the A.F.S. Building Project, under which the building is to be acquired, is to raise $100,000 within a period of three years through individual contributions from those who have benefited from the Society's activities over the past 54 years. Contributions and pledges have already come in from a number of individual members and chapters.

Alumni Group Supports Plan

Under the leadership of A.F.S. President Walton L. Woody, the idea for a permanent Headquarters was first presented to the Society's Alumni Group on May 11 during the 1950 Convention. It was felt that the reaction of this group, composed of past officers, directors, medalists, and honorary life members, was essential to full support of the project. The group approved enthusiastically and some $8,000 was pledged immediately, including sums from distinguished foreign guests in attendance.

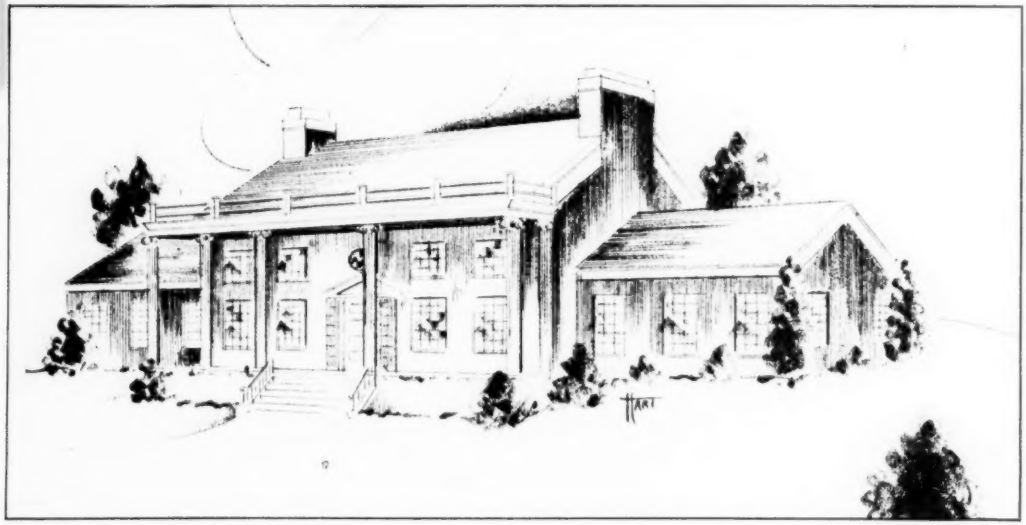
In presenting the plan, President Woody (at that time vice-president) said:

"All of us have made our livelihood, and in many cases a good one, from the foundry industry. We could not have accomplished this alone, but only in collaboration with each other. Our equipment, material, and techniques could only have been developed by such cooperative effort as the American Foundrymen's Society has provided for over half a century."

In recent years the Society has paid rentals of over $16,000 a year for its National Headquarters. A reduction of some 38 per cent in rental was accomplished in moving to the present location, but there is no assurance that present rentals will not be materially increased on expiration of the current three-year lease. The National Office now occupies some 5,300 square feet of space, and an area of approximately 7,000 square feet is contemplated in the permanent home plan. This would provide space not now available for a technical library, conference room, and storage for all A.F.S. publications.

A permanent headquarters building has been discussed by A.F.S. for many years. Meanwhile many other technical societies—ASM, ASTM, ASME, ASTE, Western Society of Engineers, and Detroit Engineering Society—have acquired their own offices and the American Ceramics Society has initiated a program leading to its own building.

Artist's conception of proposed permanent home for the American Foundrymen's Society.



Over $30,000 has already been pledged to the A.F.S. Building Fund, including personal pledges ranging from $50 to $1000. Contributors of large amounts are, of course, interested in the question of deductibility from income tax. In the opinion of the A.F.S. attorney, contributions to the A.F.S. Building Fund are deductible "so long as objects of the Society are as at present, that is, of a scientific and educational nature, and if the proposed building is limited to use as a home for the Society." Development of the project will be maintained within these requirements for deductibility of contributions.

Over $30,000 Pledged to Date

It is estimated that 40 per cent of the $100,000 goal may be contributed by the A.F.S. Alumni Group, in view of the fine response to date. Success of the project involves raising the balance of $60,000 from the remaining 8,000 members of the Society on the basis of $9 per member over the three-year solicitation period, or $3 per member per year.

Success of the project depends upon the support of chapters, as well as of the Alumni Group and the personal members. As of August 21, over $10,000 had been pledged by only 10 chapters, an average of $1,000 per chapter. No chapter has declined to either participate in or support the program and some unique fund-raising plans have been initiated, such as raffling television sets. It is believed that fully $30,000 will be contributed by the chapters.

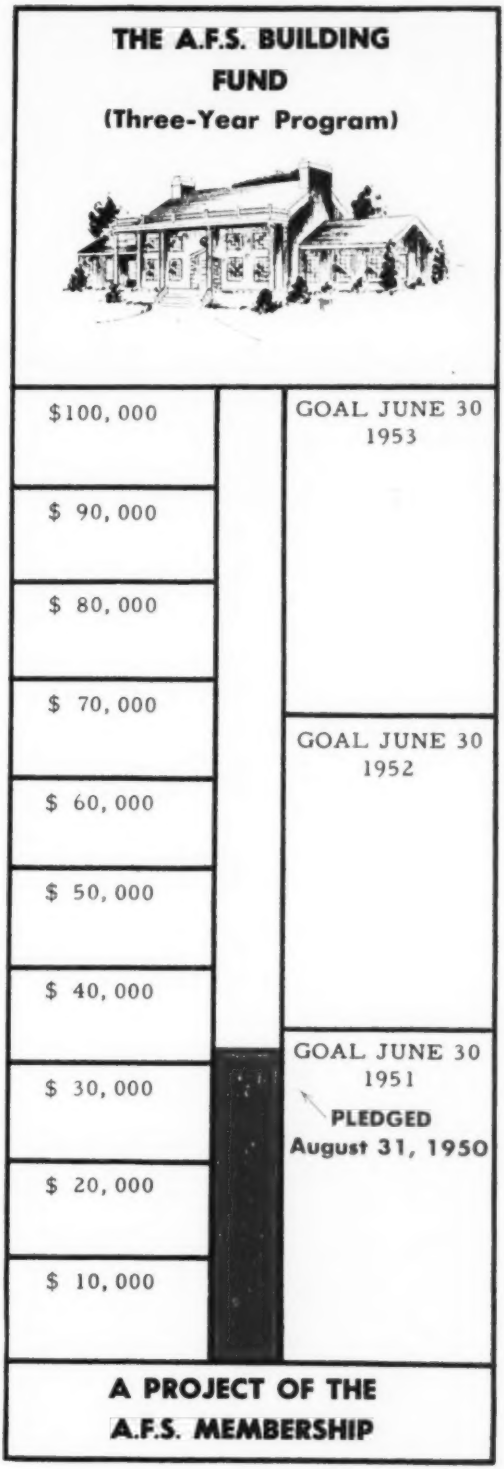
Financed Only through Contributions

It is the desire of A.F.S. to make maximum use of operating funds for the development of technical information within the purposes of the Society. For this reason, the Board of Directors believes that the estimated cost of a permanent headquarters should be raised by contributions rather than be financed from existing operating funds. All building funds will be kept intact and separate from the operating funds, and will be disbursed only for purposes of the A.F.S. Building Project.

Such questions as locality, and whether to put up a new building or remodel some existing structure have not been considered to date. Appropriate committees for acquiring sites, development of plans, building or remodeling, etc., will be appointed and their findings will be subject to final approval of the Board.

Officers of A.F.S. chapters and members of the Society's Alumni Group have pledged their wholehearted cooperation in furthering the three-year project and in many instances have made either substantial personal contributions or contributions on behalf of the chapters they represent. Individuals, companies, A.F.S. chapters and other groups desiring to donate to the project are requested to send their contributions to the Secretary-Treasurer, American Foundrymen's Society, 616 S. Michigan, Chicago 5, Ill.

As the world's foremost foundry technical society, representing one of the most important and basic industries, the American Foundrymen's Society has during the half-century of its existence acquired world-wide prestige. It is fitting that such an organization have a national home that will be a source of pride to every A.F.S. member throughout the world.



GATES and RISERS

for high-dross non-ferrous alloys

H. W. Bennett
Foundry Apprentice Supervisor
Dominion Engineering Works, Ltd.
Montreal, Que., Canada

GATES AND RISERS reflect the individuality of the skilled molder more than any other operation connected with the art and science of making molds. Proper application can make the difference between success and failure of the casting.

Except in machine molding, gates and risers are the only parts of the mold made without special indications on the pattern as to location and size, although the trend in some shops is to give this information. In general, on miscellaneous molding jobs the molder thinks this out for himself.

Different classes of work and different alloys require different treatment. In ornamental castings the gate must not interfere with the design. For light castings, the gates must be constructed so as to avoid misruns, and on heavy castings erosion must be prevented.

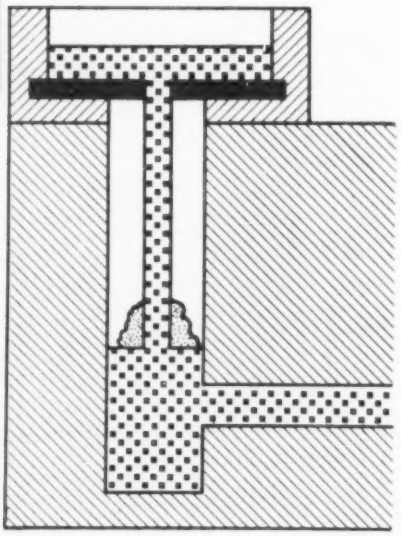
Gates should be designed to feed with hot metal parts in the mold where risers are placed. But a gate which is ample and successful for gray iron will many times fail if used on a similar casting made in bronze, and would certainly fail if used for steel. Nevertheless basic principles underlying the application of gates and risers are the same for ferrous or non-ferrous metals and many of the features found in one type of foundry are applicable in others. No rules for making gates and risers have yet been established for universal use but work is constantly going on in the field and foundrymen may someday be able to calculate the best size, shape, and location of gates and risers.

At present these factors are determined by experience and experimentation. This requires knowledge of the behavior of metal during cooling and solidification, experience, and good foundry judgment.

The ideal gating system enables filling the mold sufficiently fast to prevent cold shuts, but does not subject the mold cavity or gating system to undue pressure or erosion. Along with appropriate location of risers, the ideal system avoids hot spots and permits the metal to solidify directionally. In general, to accomplish this, solidification should start farthest from the last source of liquid metal, progressively approaching it whether it is a riser or gate or both.

Whether to gate at the top or the bottom is a decision to be made on the basis of experience. Guiding factors may be the type of metal, design of the pattern, or some mechanical or operational feature of the casting. Clean, sound castings can be poured through top gates or through bottom gates.

Principal disadvantage of bottom gating is that it interferes with the ideal process of metal solidification which should begin at the bottom of the casting and



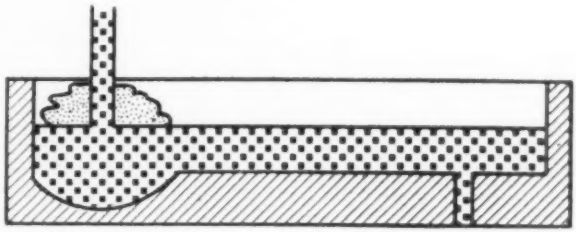


Fig. 1—Sketches showing large-sprue type of gating system. Below—pouring basin with dross clinging around pouring system while clean metal runs through small opening at top of large sprue. Left—dross formed at bottom of the large sprue floats above the ingate, allowing clean metal to enter the mold at its lowest point.

progress upward to the top where the final shrinkage is compensated by liquid metal from a gate or riser. Where very large risers or feeders are employed this disadvantage of bottom gates is not so significant.

Some types of non-ferrous alloys produce dross upon the slightest disturbance. With such alloys—aluminum, manganese, and silicon bronze—special gating is the only solution to the problem of obtaining clean castings. Gates used must take advantage of the high degree of fluidity of these metals, and of the bulky dross which forms quickly, clings together readily, and clings around the pouring stream. Generally a much larger sprue diameter than usual is used and the metal flow is checked below the pouring basin.

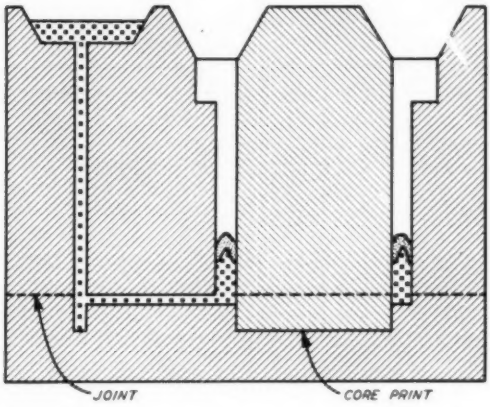


Fig. 2—Example of ordinary bottom pouring system showing dross formed by turbulence in pouring sprue.

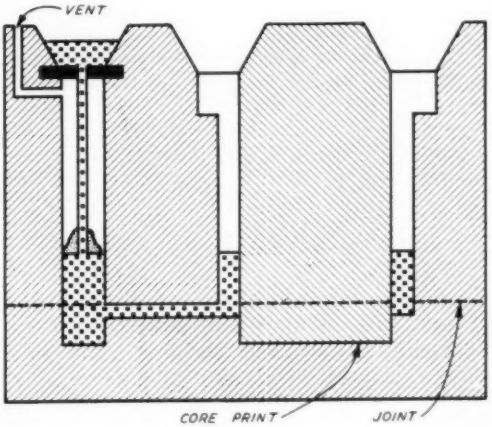


Fig. 3—In this gating system pouring speed is controlled by the use of a choke at the sprue entrance.

Many types of skim gates are available to hold dirt and dross in the sprue or pouring basin during pouring, but they are of no use in checking formation of dross caused by the disturbance of metal flowing over uneven surfaces in a mold. Serious dross formation may occur in the mold cavity if the metal cascades over irregularities, washes against cores, or sprays into the mold due to pressure in the sprue.

To overcome this condition bottom pouring must be used. The metal should enter the mold cavity at the lowest level in the mold and rise gently without any disturbance in the mold cavity throughout pouring. Where there are several low sections in a mold, these have to be connected by small gates formed by the pattern or cut by the molder, to prevent one section filling and overflowing into other adjoining sections.

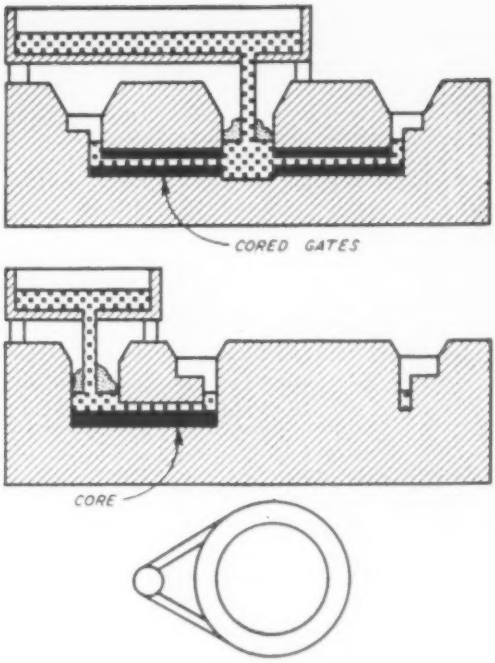


Fig. 4—Variations of the gating system shown in Fig. 3 were used in pouring large gun training gear castings.

Fig. 5—The gating system shown in Fig. 4 was used to control pouring speed for this ring-shaped casting.

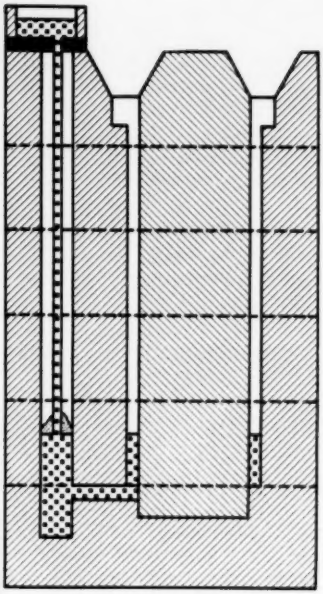


Fig. 6 (left)—The use of the gating system shown for bottom-pouring or deep bushing casting generally would result in shrinkage in the middle section of the casting which the riser would not be able to feed.

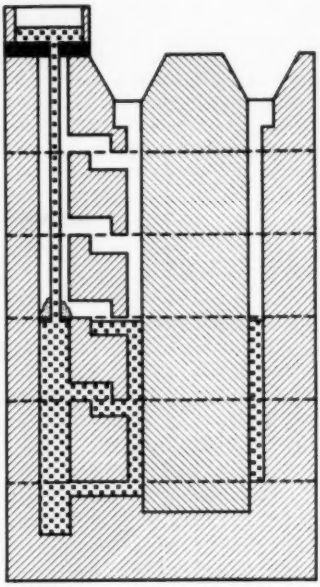


Fig. 7 (right)—Branch gates are used to overcome the feeding difficulty of the gating system shown in Fig. 6. Each gate is provided with a trap which effectively prevents entrance of dross into the mold cavity.

Good and bad gating practices for the special bronzes are illustrated by the sketches. Figure 1 illustrates the large-sprue type of gating system. The lower sketch shows a pouring basin with the dross clinging around the pouring stream while clean metal runs through the small opening at the top of the large sprue. The sketch (left) shows how more dross formed at the bottom of the large sprue floats above the in-gate allowing clean metal to enter the mold.

Ordinary bottom pouring is shown in Fig. 2. Here turbulence in the pouring sprue causes dross to form which no skim gate can prevent. As the metal rises and becomes colder this dross clings to the sides of the mold cavity and becomes enveloped, and is only discovered when the casting is machined.

Controlled pouring speed is achieved with a gating system similar to that shown in Fig. 3 which chokes the metal as it enters the sprue. There is no disturbance in the mold cavity because metal in the sprue and in the cavity are maintained at the same level throughout pouring. The pouring basin merely controls pouring and is not intended to trap dross.

Even in shallow ring-shaped castings this type of gating is advantageous. Figure 4 shows two variations used successfully on training gears made for guns during World War II. These castings had teeth machined all around the inner wall and any imperfection from dross or gas-holes would scrap the casting.

The upper sketch (Fig. 4.) shows a casting about 8 ft in diameter and about 10 in. high. Casting weight with sprue was about 1500 lb. In-gates entered the casting at four points. A casting of somewhat smaller size made with this gating system appears in Fig. 5. In Fig. 4, lower, V-shaped gates were cut from the large sprue to two points in the mold cavity. Weight of this ring gear was about 600 lb. The casting measured approximately 5 ft in diameter and 6 in. deep.

Problems in gating deep bushings are illustrated by Figs. 6 and 7. The bushing in Fig. 6 is about 6 ft high and the danger in gating it in the way illustrated is encountered in all bottom poured castings regardless of the metal as pointed out previously. Even if hot metal is poured into the riser as the metal comes up into it, the riser would not be able to supply metal to the voids created by shrinkage occurring in the middle section of the casting. The defect resulting is generally referred to as secondary shrinkage.

Branch gates (Fig. 7) can be used to overcome this difficulty. Instead of straight branch gates which might admit dross, each gate has a trap. When the metal enters the gate from the sprue, the lower half has already been filled from the mold cavity. This effectively prevents dross from entering the cavity resulting in clean, hot metal being fed into the casting right up into the riser.

Transactions of 1949 International Foundry Congress Now Available

PUBLISHED by the Netherlands' *Metalen* magazine, proceedings of the 1949 International Foundry Congress, held last fall in Amsterdam, are now available in a 309-page *Congresboek*.

The *Congresboek* is published in three languages, English, French and Dutch, with the majority of papers in English. Fully-illustrated with photomicrographs, photographs, charts and tables, the *Congresboek* contains papers on such subjects as melting and metallurgy of ferrous and non-ferrous alloys, diecasting, heat transfer, nodular iron foundry sand practices, materials handling in the foundry, nondestructive testing of castings, patternmaking, core and molding practices and many other phases of the castings industry, written by internationally-known authorities.

APPRENTICE TRAINING "DOWN UNDER"

Recent reports from Australia indicate that in common with countries all over the world there is a shortage of foundry apprentices. To quote the *Australian Foundry Trade Journal*—"to allow the shortage of foundry apprentices to become a permanent feature is to commit industrial suicide."

TRAINING OF SKILLED WORKERS for foundries in Australia is being accomplished today through systems of apprentice and post-apprentice training created by industrial arbitration acts and apprenticeship codes passed by the various states of the Commonwealth of Australia.

In New South Wales, for instance, indenture agreements between employer and apprentice require that the employer pay for a technical education offered by the New South Wales Education Department in an appropriate trade or diploma course. This education may also be acquired through completion of courses offered by the employer but subject to rigid control by the government of the state.

Many Schools Offer Courses

Throughout the whole of Australia, there is but one way in which a youth can become a tradesman—by serving either a four-year or a five-year apprenticeship. If the apprentice when indentured is under 17 years of age, the period of apprenticeship is five years; if over 17, the period is either four or five years, at the option of the contracting parties.

Trade courses established by the New South Wales Department of Education require three years of high school, or an equivalent education, for entrance. A highly progressive foundry apprenticeship training program offers both apprenticeship and post-apprenticeship courses at a nominal cost at the Central Technical College in Sydney and at the Technical Colleges in Newcastle and Wollongong. The Central Technical College alone has six branches in Sydney and 29 branches in rural centers.

The apprentice is allotted one day every fortnight by his employer to attend the trade course, which is spread over a period of four years and embraces trade technology, trade science, trade mathematics, trade drawing and practical work.

With the exception of one night a week, all courses are given during the day, without loss of pay to the apprentice. Summarized, the apprentice's study time table is as follows:

SUBJECT	HOURS PER WEEK IN EACH STAGE			
	I	II	III	IV
Technology	1	1	1	2
Trade Science	—	—	1	1
Trade Mathematics	1	1	1	—
Practical Work	2	2	3	3
Trade Drawing	2	2	—	—

Requiring four years to complete, the Trade Technology section is devoted to lectures on the foundry industry and its history, safety practices, pattern-making, molding sands and clays; green sand, dry sand and loam molding; runners and risers, gray iron, ferrous alloys, malleable iron, sand control, non-ferrous foundry practice, special alloys, aluminum alloys, and steel foundry practice.

The Foundry Trade Science section teaches both inductive and deductive scientific reasoning as applied to the foundry by (1) presenting a casting problem to be solved, (2) finding and analyzing subject matter necessary to solve the problem, and (3) finding applications of this solution to other foundry problems. In addition, apprentices are acquainted with gaseous non-metallic elements and their compounds, solid non-metallic elements, metallic elements and compounds.

Trade Mathematics includes instruction in the use of symbols, and simple formulae, indices and index laws, simple and simultaneous equations and their solution, and calculations dealing with the mixing of alloys. This course is based on an assignment system

which makes it possible for the student to complete the course in three years, leaving the time thus saved for practical work.

Practical Work is devoted principally to instruction and practice in molding operations – mixing sand, plate molding, rollover work, forming uneven parting lines, molding with green sand cores, split pattern molding, use of patterns requiring three-part molds, bedding in, runners and risers, open sand molding, coremaking, ramming, venting, drying and finishing of cores, coring and closing of molds, pipe molding; molding sheave wheels, pulley wheels, and tooth wheels; dry sand molding, loam molding, and sand control and preparation. Other subjects offered are furnace control and non-ferrous, gray iron and steel foundry practice.

Trade Drawing is divided into two parts, given during the apprentice's first and second years– (1) print reading and sketching, and (2) mechanical drawing. The apprentice must pass the first course before going on to the second.

These courses for the apprentice are modified constantly and improved by an Advisory Committee, consisting of key members of the New South Wales Technical Education Department and representatives of the foundry industry.

Post Apprenticeship Courses Offered

In addition to the Apprenticeship Trade Course outlined above, the New South Wales Department of Education offers a post-apprenticeship course in Foundry Technology, open to graduates of the Apprenticeship Trade Course and to all foundrymen. Designed to provide more detailed coverage of subjects offered in the Apprenticeship Trade Course, this advanced course teaches such knowledge of metallurgy as is required by the foundry executive or technician but does not go into the subject as deeply as a regular diploma or university course.

Another adult course offered by the Central Technical College, Sydney, and the Technical Colleges at Newcastle and Wollongong is that in Engineering Technology, designed to give engineers a close, practical insight into foundry practice. Two terms of the first year are given over to composition and conditioning of molding sand, sand testing and control, methods of melting and casting, and to the composition and properties of cast alloys. For the practical section of the course, floor and machine molding are taught, as are melting and casting of all types of ferrous and non-ferrous metals. The second year of the course deals with heat treatment of steels and alloys and with welding.

A third course offered at the post-trade (adult) level is that in Advanced Trade Metallurgy, which is divided into three terms each on theory and the practical aspects of metallurgy, including the use of the microscope.

On a higher educational level than the Technical Colleges are the Technical Universities, and higher still, the Australian Universities (purely academic), all of which are sponsored by the Australian government and conform to recognized British university standards. There is a Technical University in each Australian state–Sydney University for New South Wales, Melbourne University for Victoria, etc–and the courses offered lead to degrees in engineering and the arts and sciences after from three to five years.

A plan is now being formulated whereby the apprentice course graduate transfers from the Technical College to the Technical University to work toward a degree. This plan, similar to the cooperative student plan in effect in some United States universities, requires that the student take courses in engineering for six months of each year, and for the remaining six months be employed in industry. Upon completion of the four-year course the student receives the degree of bachelor of engineering (Technical University).

Law Stipulates 1 Apprentice to 2 Molders

Apprenticeship in Australia is very closely related to trade union activities. The Australian Federal Metal Trades Award, a law governing activities of the metal industry, stipulates that there be one apprentice to two tradesmen molders throughout the industry. This ruling can, however, be countermanded by the Australian Apprenticeship Council if it is found that an employer has facilities to train a greater number of apprentices than the 2 to 1 ratio established by law. This Apprenticeship Council consists of an apprenticeship commission appointed by the government and one representative each from the trade union and the employers' group.

The most progressive state in apprentice training for the foundry industry is New South Wales, whose educational facilities for apprentice, post-apprentice and university-level training have been described in this article. Technical training varies among the several Australian states, and in most facilities for the training of foundry apprentices are inadequate. This is due primarily to the low population density of most Australian states. It must be remembered that while Australia has the same area as the United States, its population is roughly equal to that of New York City.

Intensive "New Blood" Campaign Underway

Each year approximately 6,500 young men enter trades in New South Wales. Of these, 50 per cent are employed by the metal trades. In 1948, 1,775 boys entered the fitting and turning trade, as compared with 40 entering the molding trade. Because of the low intake of apprentices into foundries, there is a shortage of apprentices and tradesmen. Employers and employee representatives are alarmed at the number of young men who will drift into dead-end jobs and are sponsoring radio broadcasts and printing and circulating brochures and posters throughout Australia citing the opportunities that exist for young men in the foundry industry.

In line with this, the New South Wales Education Department has established pre-apprenticeship training courses in technical high schools. The student continues to take the same secondary school subjects as an ordinary pupil, but takes his pre-apprenticeship course during the time that is normally allotted for his technical studies. In this way it is hoped that more of Australia's youth will become trade conscious, particularly with relation to the foundry industry.

Foundry Good Will Ambassador

PROMOTING GOOD WILL not only for his company but for the entire metal castings industry is the hobby of Earl M. Strick of the Erie Malleable Iron Co., Erie, Pa., shown in the accompanying photograph pointing out features of the heavy duty malleable iron wheels cast by his company to one of the many groups he has appeared before in recent years.

He has extolled the advantages of castings and the foundry industry's importance to the national economy

at meetings of college, high school, grammar school, parent-teacher, civic, service, professional, social and church groups in and about Erie for many years and has preached the twin gospels of "Castings Can Do It Better" and "The Foundry Is a GOOD Place to Work" to varied groups throughout northwestern Pennsylvania, western New York and eastern Ohio.

Long active in the American Foundrymen's Society, Mr. Strick was co-organizer of the A.F.S. Northwestern Pennsylvania Chapter, serving as its second chairman, and is today its secretary-treasurer. He has spoken before chapter, regional and national meetings of the Society and has been a frequent contributor to the trade and technical press.

Request Nominations For 1951 A.F.S. Gold Medal, Life Membership Awards

CALL FOR NOMINATIONS of individuals whose contributions to the foundry industry merit consideration of the Board of Awards for awarding of Gold Medals and Honorary Life Memberships in the American Foundrymen's Society has been sent to officers and directors of the Society, chairmen and vice-chairmen of A.F.S. technical divisions and general interest committees and to chairmen of the 40 chapters of the American Foundrymen's Society.

From the candidates nominated, the A.F.S. Board of Awards, consisting of the last seven living Presidents of the Society, will select those men whom it deems most worthy to be honored by the presentation of A.F.S. Gold Medals or Honorary Life Memberships in the Society at the 55th A.F.S. Convention, to be held in Buffalo, April 23-26, 1951.

Nominations must state fully the name of the individual and the explicit reasons for which he is being nominated and must include complete data on his background only as it pertains to his nomination. Deadline for the acceptance of nominations is December 1. In addition to A.F.S. officers and directors, present or past members of the Board of Awards, executive committees of any A.F.S. technical divisions or general interest committees, and chapter chairmen, any member of the Society, with the exception of Student or Apprentice Members, may nominate a candidate for these awards.

Future Meetings and Exhibits

THE INSTITUTE OF METALS, 42nd annual meeting, Bournemouth, England—Sept. 18-22.

MALLEABLE FOUNDERS' SOCIETY, general meeting, Hotel Cleveland, Cleveland—Sept. 22.

STEEL FOUNDERS' SOCIETY, annual fall meeting, The Homestead, Hot Springs, Va.—Sept. 25-26.

ASSOCIATION OF IRON AND STEEL ENGINEERS, annual convention and exposition, Cleveland Public Auditorium, Cleveland—Sept. 26-29.

ALL-CANADIAN FOUNDRY CONFERENCE, sponsored by A.F.S. Eastern Canada and Ontario Chapters, Hamilton, Ontario—Sept. 28-30.

ITALIAN ASSOCIATION OF METALLURGY, 4th national convention, Old Palace, Florence, Italy—Sept. 28-Oct. 1.

TEXAS REGIONAL FOUNDRY CONFERENCE, sponsored by A.F.S. Texas Chapter, Plaza Hotel, San Antonio, Texas—Oct. 5-6.

GRAY IRON FOUNDERS' SOCIETY, annual meeting, Netherland Plaza Hotel, Cincinnati—Oct. 12-13.

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION, annual meeting, The Greenbrier, White Sulphur Springs, West Virginia—Oct. 12-14.

NORTHWEST REGIONAL FOUNDRY CONFERENCE, sponsored by A.F.S. Washington, British Columbia, Oregon, and Oregon State College Student Chapters, Gowman Hotel, Seattle—Oct. 13-14.

NON-FERROUS FOUNDERS' SOCIETY, annual meeting, Hotel Statler, Boston—Oct. 13-15.

AMERICAN SOCIETY FOR METALS, national metal exposition and Congress, International Amphitheater, Chicago—Oct. 23-27.

NEW ENGLAND REGIONAL FOUNDRY CONFERENCE, New England Foundrymen's Society, Massachusetts Institute of Technology, Cambridge, Mass.—Oct. 27-28.

METALS CASTING CONFERENCE, A.F.S. Central Indiana and Michiana Chapters and Purdue University, at Purdue, West Lafayette, Ind.—Nov. 2-3.

NATIONAL FOUNDRY ASSOCIATION, annual meeting, Edgewater Beach Hotel, Chicago—Nov. 9-10.

STEEL FOUNDERS' SOCIETY, annual technical and operating conference, Carter Hotel, Cleveland—Nov. 9-11.

MICHIGAN REGIONAL FOUNDRY CONFERENCE, A.F.S. Detroit, Central Michigan, Saginaw Valley, and Western Michigan Chapters, Michigan State College Student Chapter, and Michigan State College, at East Lansing, Mich.—Nov. 10-11.

BIRMINGHAM REGIONAL FOUNDRY CONFERENCE, sponsored by A.F.S. Birmingham District Chapter, Tutwiler Hotel, Birmingham, Ala.—Feb. 22-23, 1951.

55th Annual Foundry Congress, American Foundrymen's Society, Buffalo, N. Y.—Apr. 23-26, 1951.

Fig. 1—Mounting board cut-out is grooved to fit edge of pattern.

Fig. 2—Outer pattern edge is grooved to fit groove in cut-out.

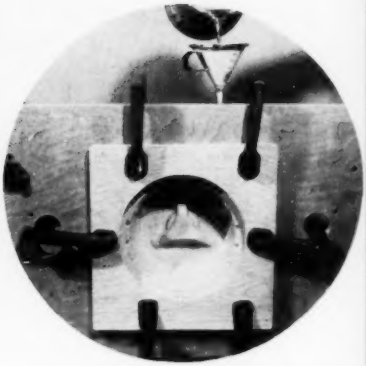


Fig. 3—A low-melting alloy poured into opening seals-in pattern.

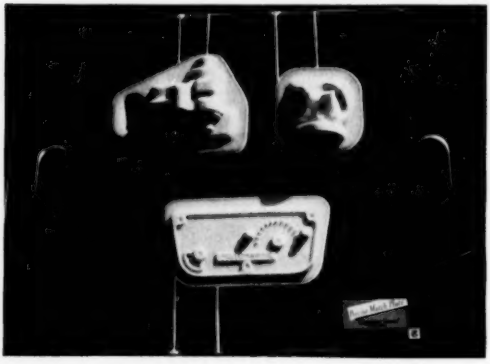
INSERTION PROCESS CUTS COST OF MATCHPLATE MANUFACTURE

Franz Schumacher
Chief Patternmaker
Cooper Alloy Foundry Co.
Hillside, N. J.

A NEW CHAPTER in the manufacture of metal, wood, and plastic matchplates has been opened with the recent development of an insertion method for mounting patterns. This patented process has been in use at the Cooper Alloy Foundry Co., Hillside, N. J., for three years as a means of inserting aluminum, brass, wood and plastic patterns in plywood boards. Patterns inserted by this low-cost method have produced up to 10,000 molds and afford a solution to the problem of providing matchplates for small order jobs at a reasonable cost.

The three conventional methods of making matchplates—(1) sand molded aluminum cast plates, (2) pressure cast aluminum plates, and (3) individually cast and mounted aluminum or brass patterns—have served the foundry industry well but it is believed that the newly-developed insertion method opens new avenues of matchplate manufacture.

Fig. 4—Demonstration lucite plate defines path of low-melting alloy used to lock pattern in place.



Sand molded aluminum cast matchplates demand a master pattern for every pattern wanted on the matchplate. These are usually made of white metal or plaster of paris. Feeding is rather difficult and back drafts are often caused by distorted parting lines resulting from shrinkage of thick sections.

Pressure plates require full flask-size plaster of paris molds carefully pieced together, with the number of pieces depending upon the number of impressions needed. The highly-skilled personnel and expensive equipment needed can be afforded by only a few pattern shops. Shrinkage on this type of matchplate is fairly well controlled, but shifts, uneven thicknesses and losses are possible and costly.

Process Has Nine Major Advantages

Individually sand-cast split patterns mounted on machined plates assure even thickness, but mounting and matching is rather expensive and patterns have a tendency to shift and loosen during foundry operations. Screw and drill holes have to be filled and watched regularly.

Cooper Alloy Foundry Co.'s experience with these three conventional types of matchplates resulted in development of the Schumacher Process, whose advantages as noted during a three-year test period are:

(1) Savings of from 50 to 65 per cent.

(2) Simplified, low-cost repair or replacement of individual broken patterns on a matchplate.

(3) Rapid duplication of matchplate.

(4) Precision matching of pattern with a minimum of effort.

(5) No shifting of patterns.

(6) Ability of personnel with minimum of experience to make accurate matchplates.

(7) Extensive elimination of cores.

(8) Increased use of the inherent advantages of plastic patterns and elimination of disadvantages.

(9) Manufacture of metal, wood and plastic matchplates in any pattern shop without the use of special, costly equipment.

Although the process described covers more than the insertion of patterns, it is this insertion that is the heart of the development because it permits the anchoring of metal, wood and plastic patterns without the use of fastening devices.

The pattern is inserted as follows:

(1) Opening of the same size and shape as pattern outline is cut into mounting plate. For aluminum plates cut-out may be cast directly.

(2) Inside of cut-out in plate and outside section of pattern fitting cut-out in the plate is grooved by router. (See Figs. 1 and 2).

(3) Pouring hole is drilled from edge of plate to cut-out groove.

(4) Vent hole is drilled from plate edge to groove.

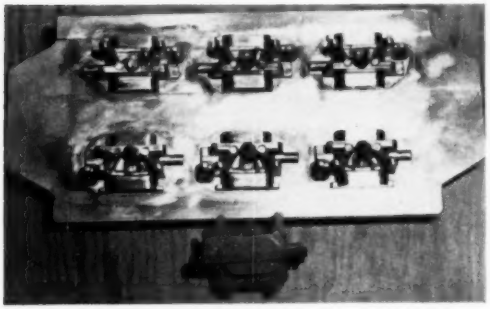


Fig. 5—These six plastic patterns are individually inserted on ½ in. thick aluminum matchplate.

(5) Pattern is inserted and clamped in place (See Fig. 3).

(6) Low-melting alloy is poured through hole to seal pattern in place. (See Fig. 3).

Figure 4 shows lucite matchplate which clearly defines path of low melting alloy that locks pattern in place. Plate illustrated is for demonstration purposes and not designed for foundry use.

Aluminum matchplate (Fig. 5) has six individually-inserted plastic patterns in ½-in.-thick machined plate. Thickness of machined plate is of major importance for close core fit and accurate casting dimensions and prevents fins on castings. Machined and sand blasted aluminum plates for all flask sixes can be obtained at a reasonable cost from supply firms.

Aluminum plate with 90 plastic patterns inserted (Fig. 6) is one of finest examples of matchplate work ever produced. Plate is machined and sand blasted for non-slip and has six plastic inserts with 10 patterns in each and six plastics with five patterns in each, with at least 1 in. of metal between each insert to strengthen plate. Besides being a precision matchplate, example shown illustrates possibilities of using plastic materials for patterns. The plastic coatings are all alike and are made in a small plaster of paris mold,

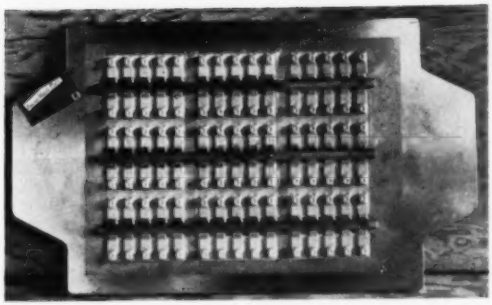


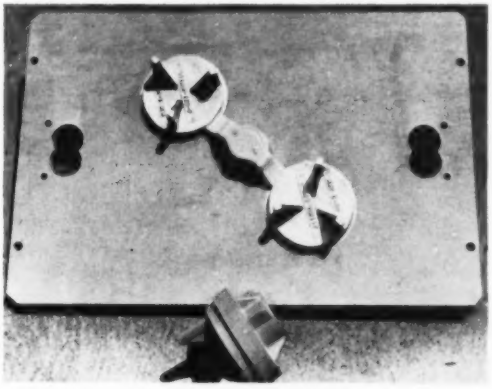
Fig. 6—This unusually fine example of a machined and sandblasted matchplate has six plastic inserts with 10 patterns in each and six with five patterns.

instead of in a full flask-size plaster mold. Cost of this type of plate is far below the price of an all-aluminum plate because of savings in finishing.

Figure 7 shows one of the less costly types of matchplates with two aluminum patterns inserted in a ¾-in. plastic-coated plywood board. This, in the opinion of the author, is the solution to many problems involving small-order jobs that do not justify expensive matchplate equipment. Two more aluminum patterns could be inserted at only a slight additional cost. This type of matchplate can be used for 25 castings or for ten thousand castings.

It has been contended that these ¾ in. plywood boards are too thick, but in the author's opinion this is untrue since many foundries mount patterns on boards up to 2-in. thick. These 2-in. boards have less strength than the ¾-in. plywood boards and cost 10 times as much. This same plastic-coated plywood board also has many uses in pattern shops and costs approximately half as much as ordinary board with three coats of paint. The advantages of plastic-coated plywood boards have been proved at Cooper Alloy, where plastic patterns have been inserted on more than 3,000 matchplates with excellent results.

Fig. 7—Economical matchplate with two aluminum patterns inserted in ¾-in. plastic coated plywood board is especially applicable to small-order jobs.



HOLDING EARLY FALL REGIONALS IN ONTARIO, TEXAS, WASHINGTON

Heading the list of 1950-51 regional foundry meetings is the All-Canadian Foundry Conference, September 28-30, closely followed by the Texas Regional on October 5 and 6 and the Northwest Regional—being held for the first time this year—on October 13 and 14. Other regional conferences scheduled for 1950 include the New England Regional, to be held October 27-28; the Metals Casting Conference November 2-3, and the Michigan Regional on November 10-11. Program details of the first three conferences are published below and full information on the others will appear in American Foundryman as it is released by the respective conference publicity chairmen.

All-Canadian Foundry Conference

Program for the Third A.F.S. All-Canadian Conference announced by Conference Chairman R. H. Williams, Canadian Westinghouse Co., Ltd., Hamilton, Ontario, includes a surprise session on nodular iron with Prof. Albert De Sy, University of Ghent, Belgium, as speaker. Other features are a two-and-a-half day sand course, technical sessions for ferrous and nonferrous foundrymen, plant visitations, and a banquet with an outstanding humorist and philosopher as speaker.

Headquarters for the conference will be at the Royal Connaught Hotel, where all sessions will be held. Reservations can be made through R. A. Woods, Geo. F. Pettinos, Ltd., 42 James St. S., Hamilton. Complete program—with the theme: "Good Castings are Permanent"—reported by Publicity Chairman G. R. Winkworth, Toronto Foundry Co., Ltd., is:

All-Canadian Conference Chairman R. H. Williams, Canadian Westinghouse Co., Ltd., Hamilton, Ont. (left), and Curator J. Waumsley, Brant Museum, Burlington, Ont., examine cast iron stove over 200 years old.

Thursday, September 28

9:00 a.m.—Registration.
9:30-12:00 a.m.—Sand Course, directed by Harry W. Dietert, Harry W. Dietert Co., Detroit.
12:30 p.m.—Luncheon.
2:00 p.m.—Plant Visits. Canadian Westinghouse Co., Ltd. Dominion Foundries & Steel, Ltd. International Harvester Co., Ltd. Tallman Bronze Co. Massey Harris Co., Ltd. "M" Foundry, Brantford, Ont.
2:00 p.m.—Sand Course, directed by Harry W. Dietert, Harry W. Dietert Co., Detroit.
6:30 p.m.—Opening Dinner. Speaker: Bruce L. Simpson, National Engineering Co., Chicago.

Friday, September 29

9:00-12:00 a.m.—Sand Course, directed by Harry W. Dietert, Harry W. Dietert Co., Detroit.
10:00-12:00 a.m.—Plant Visits. Canadian Westinghouse Co., Ltd. Dominion Foundries & Steel, Ltd. International Harvester Co., Ltd. Tallman Bronze Co. Massey Harris Co., Ltd., Foundry "M", Brantford, Ont.
2:00 p.m.—Non-Ferrous Session. James G. Dick, Canadian Bronze Co., Ltd., Montreal. *"Melting of Brass and Bronze."*
Ferrous Session. Harold N. Bogart, Ford Motor Co. of Canada, Ltd. *"Up-to-date Melting Mediums for Cast Iron, Malleable and Steel."*
Sand Course, directed by Harry W. Dietert, Harry W. Dietert Co., Detroit.
6:30 p.m.—Reception. Royal Connaught Hotel.
7:00 p.m.—Banquet. Speaker, E. A. McFaul, Chicago.
9:00 p.m.—Entertainment.

Saturday, September 30

9:00-12:00 a.m.—Sand Course, directed by Harry W. Dietert, Harry W. Dietert Co., Detroit.
10:00 a.m.—Special Technical Session. Speaker: Dr. Albert DeSy, University of Ghent, Ghent, Belgium. *"Nodular Iron."* Discussion Leader: J. E. Rehder, Mines Branch, Canadian Department of Mines and Technical Surveys, Ottawa, Ont.

Texas Regional Foundry Conference

Texas Regional Foundry Conference, to be held October 5 and 6 at the Hotel Plaza, San Antonio, is sponsored jointly by the A.F.S. Texas Chapter and the A.F.S. Texas A & M Student Chapter, with James R. Hewitt of Houston as General Chairman and Walter J. Temple, San Antonio, co-chairman.

Included on the two-day program are technical sessions on patternmaking and gray iron, non-ferrous, steel and sand. Highlights of the Conference will be a luncheon, with A.F.S. President Walton L. Woody as speaker, a Texas Barbecue, and a banquet with San Antonio's Mayor White and Dr. Harold Vagborg, director of the Southwest Research Institute speaking. Complete program is as follows:

Thursday, October 5

8:00-9:30 a.m.—Registration.

10:00-12:00 a.m.—General Meeting. A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee, *"Patterns As They Influence Foundry Operations."* Harry J. Jacobson, Industrial Pattern Works, Chicago, *"Core Boxes for Core Blowing."*

12:30 p.m.—Luncheon. Speaker: A.F.S. National President Walton L. Woody. Introduction by T. L. Shartle, President, Steel Founders' Society of America.

2:00 p.m.—Sectional Meetings.

Steel. W. B. Ziegelmueller, Electric Steel Casting Co., Indianapolis. *"Labor Aids in the Steel Foundry."*

Gray Iron. D. J. Reese, International Nickel Co., New York, *"Present Status of Ductile Iron."*

Non-Ferrous. I. E. Kramer, William F. Jobbins, Inc., Aurora, Ill., *"Aluminum Gating, Risering and Foundry Practice."*

3:30 p.m.—Synthetic Sands Session. C. A. Sanders, American Colloid Co., Chicago, *"Synthetic Foundry Sand Practice."* Natural Bonded Sands. E. C. Sawyer, Ayres Mineral Co., Zanesville, Ohio, *"Availability and Application of Natural Bonded Sands.*

6:30 p.m.—Texas Barbecue.

Friday, October 6

9:00-12:00 a.m.—General Meeting. Subject: *"Does Core Blowing Belong in My Shop?"* Speakers: Zigmund Madacey, Caterpillar Tractor Co., Peoria, Ill.; L. P. Robinson, Archer-Daniels-Midland Co. (The Werner G. Smith Co. Div.), Cleveland; L. D. Pridmore, International Molding Machine Co., LaGrange Park, Ill.

12:30 p.m.—Round Table Luncheon. Steel: J. A. Bowers, American Cast Iron Pipe Co., Birmingham, Ala., *"Melting Practice for Steel Castings."* Gray Iron: A.F.S. Technical Director S. C. Massari, Chicago, *"Why Do We Do It When We Know It's Wrong?"* Non Ferrous: William Ball, R. Lavin & Sons, Inc., Chicago, *"Gating, Risering and General Discussion of Non-Ferrous Castings."*

3:30-5:00 a.m.—Sectional Meetings.

Steel. E. A. Brandler, Electro Metallurgical Div., Union Carbide & Carbon Corp., Birmingham, Ala., *"Current Alloy Practices for Steel Castings."*

Gray Iron. W. W. Levi, Lynchburg Foundry Co., Radford, Va., *"Cupola Practice."*

Non-Ferrous. R. A. Colton, Federated Metals Div., American Smelting & Refining Co., Barber, N. J., *"Melting Practice and Gases in Non-Ferrous Metals."*

7:00 p.m.—Banquet. Speakers: Mayor White of San Antonio and Dr. Harold Vagborg, director, Southwest Research Institute, *"Industrial Potential of the Southwest."*

First Northwest Regional

First Northwest Regional Foundry Conference will headquarter at the Gowman Hotel, Seattle, Wash., with meetings held on the campus of the University of Washington, Seattle. Sponsoring the Conference, to be held October 13 and 14, are the A.F.S. Washington, British Columbia and Oregon Chapters and the Oregon State College Student Chapter. Charles M. Anderson, Eagle Foundry Co., Seattle, is general chairman of the conference.

The two-day program will begin with a social hour at the Gowman Hotel, 5:30 p.m., Friday, October 13, followed by a banquet. Ladies are invited to attend both the social hour and banquet. E. K. Smith of Los Angeles, originally scheduled as banquet speaker, will be unable to attend and will be replaced by a speaker yet to be chosen.

Technical sessions will be held at the University of Washington beginning Saturday morning, October 14, and will include a session on *"Ductile Cast Iron,"* with K. L. Clark, International Nickel Co., as speaker; a showing of the newly-released Part II of *"Fluid Flow in Transparent Molds,"* which will be in color with a sound track added; *"Use of Exothermic Materials as Aids to Better Feeding,"* presented by Michael Bock, II, Exomet, Inc., Conneaut, Ohio; and a talk on *"Getting the Most Out of Your Molding Machines."* Speaker for this last session will be announced.

J. R. Hewitt

C. M. Anderson

Concluding the Conference program will be a visit to the University of Washington's Testing Laboratory, where testing demonstrations will be made, including a compression test on a 6 in. diameter cast iron bushing, using a new 2 million lb machine.

Advance registrations may be made through Norman Ekholm, Campbell Foundry Co., 3433 Airport Way, Seattle, Wash. Cost of the Conference is $6.50 per person or $10.00 per couple and includes cocktails and dinner on Friday night, luncheon at the University on Saturday and chartered bus transportation to and from the University.

Purdue Metals Casting Conference

Third Annual Metals Casting Conference, sponsored by the A.F.S. Michiana and Central Indiana chapters and Purdue University, will be held November 2 and 3 on the campus of Purdue University, Lafayette, Ind. L. L. Andrus, American Wheelabrator & Equipment Corp., Mishawaka, Ind., is Conference chairman.

Conference will include technical sessions on *"Engineering Developments in the Foundry Industry," "Good Casting Design—On Purpose!," "Current Status of the Foundry Educational Foundation," "Gating and Risering,"* and *"Fundamentals of Foundry Sand."* Other program features will be a showing of Part II of the A.F.S. Research film, *"Fluid Flow in Transparent Molds,"* an educational display of castings and a banquet, with L. P. Robinson, Archer-Daniels-Midland Co., (The Werner G. Smith Co. Div.), Cleveland, as principal speaker. Full Metals Casting Conference program will be published in the October, 1950, issue of American Foundryman.

Another Regional Foundry Conference scheduled for the latter part of this year is the Michigan Regional Foundry Conference, sponsored by the A.F.S. Detroit, Central Michigan, Saginaw Valley, Western Michigan Chapters and the Michigan State College Student Chapter, to be held November 10 and 11 at Michigan State College, East Lansing, Mich. Full details of the Conference will be published in subsequent issues of American Foundryman.

BINARY COPPER-BERYLLIUM CASTING ALLOYS

Vaughn D. Hildebrandt
Asst. Prof., Metallurgical Engineering
University of Illinois
Urbana, Ill.

THE INDUSTRIAL ROLE of the wrought copper-beryllium alloys, i.e., strip, sheets and rods, has been well established since the discovery of the remarkable "spring" properties of the alloys[1]. The cast copper-beryllium alloys have received but slight attention. New uses, however, are being found for the cast alloys[2].

Literature published to date is concerned with the commercial alloys. These alloys are, in reality, complex alloys for they contain appreciable amounts of cobalt and/or nickel, as well as the impurities, iron, silicon and aluminum. The explicit roles of the additives are: (a) act as grain refiners during the solidification of the castings; (b) inhibit grain growth in recrystallized wrought alloys; (c) influence the amount of grain boundary precipitation of the hardening phase during aging. The increase in physical properties resultant from grain refinement and controlled precipitation makes the alloys more susceptible to commercial use.

Fundamental data relating the tensile strength, hardness, elongation and microstructures of the binary copper-beryllium alloys have not been adequately reported. The data presented herein will show this relationship in some detail.

The series of alloys chosen for investigation represent the useful range of the high-strength alloys, i.e., the beryllium content ranges from 1.78 to 2.82 per cent.

Fig. 1—96.91 per cent Cu-2.82 per cent Be alloy in the as-cast condition. Electrolytic etch. X100.

The analyses of the alloys used are summarized in Table 1. The impurities have been kept at a minimum, which makes the alloys nearly binary in character.

The casting procedure used did not deviate extensively from the techniques employed in casting the commercial alloys[3]. Melting was carried out in a gas-fired, pot-type furnace in which a slightly reducing atmosphere was maintained. The reducing atmosphere minimizes the loss of beryllium through its deoxidation of the melt but allows some gas (hydrogen and carbon monoxide) pick-up. Each melt was made in the following fashion: (a) a weighed quantity of electrolytic-copper punchings was melted under a protective covering of graphite. When the punchings were completely melted, the temperature of the melt was raised to 2000 F; (b) at this point, the required amount of beryllium was added in the form of a 4 per cent Be "master alloy."

After the "master alloy" had dissolved, the temperature of the melt was raised to 2300 F, for the purpose of homogenizing the melt, cooled back to 2000 F, and then poured into baked core-sand molds as rapidly as possible. With increasing beryllium content the pouring temperature may be lowered approximately 50 F for every 0.25 per cent Be over 2.0 per cent. The general casting characteristics of the alloys are good provided the pouring temperature is closely controlled.

After the cast test bars had cooled to approximately 1000 F they were removed from the molds, air-cooled to room temperature, and then cleaned prior to machining. After machining to size the test bars were ready for heat treatment, i.e., solution heat treatment followed by quenching and artificial aging, and testing. The properties investigated were ultimate tensile strength, hardness and elongation.

The properties of the as-cast alloys are summarized in Table 2. The microstructures of the as-cast alloys are shown in Figs. 1-3. The photomicrographs of all the as-cast alloys show "non-equilibrium" beta solid-solution in a matrix of alpha solid-solution. All the alloys show dendritic segregation which increases as the beryllium content is increased.

The heat treatment of the remaining test bars con-

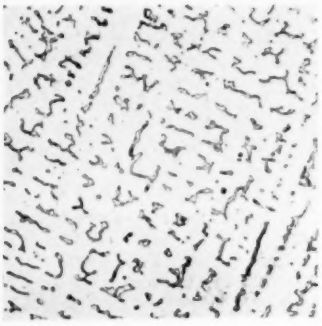


Fig. 2—As-cast 97.48 per cent Cu-2.26 per cent Be alloy. Electrolytic etch. X100.

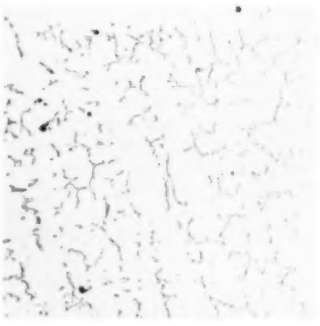


Fig. 3—Copper-beryllium casting alloy (97.79 per cent Cu-2.01 per cent Be) in the as-cast condition. Electrolytic etch. X100.

TABLE 1—BERYLLIUM ALLOYS ANALYTICAL DATA

Heat Number	1	2	3	4	5
Beryllium, %	2.82	2.61	2.26	2.01	1.78
Copper, %	96.91	97.16	97.48	97.79	97.98
Fe, Si & Al, %	0.26	0.23	0.26	0.20	0.24

TABLE 2—PHYSICAL PROPERTIES OF AS-CAST BINARY COPPER-BERYLLIUM ALLOYS

Composition, Be, %	Ultimate Tensile Strength, psi	Rockwell Hardness	Elongation, %
2.82	80,000	47G	25
2.61	75,000	40G	21
2.26	55,000	68B	17
2.01	40,000	54B	15
1.78	30,000	34B	12

sisted of solution heat treating the alloys at 1510 F for 15 min, quenching into water at 60 F, followed by aging at 680 F in order to obtain maximum hardness. The physical properties of the solution heat treated and quenched alloys are summarized in Table 3. The microstructures of the alloys after solution heat treatment and quenching are shown in Figs. 4-6. The photomicrographs show equilibrium high-temperature beta solid-solution in a matrix of beryllium-rich alpha solid-solution.

The physical properties of the alloys after solution heat treatment, quenching and artificial aging to produce maximum hardness are summarized in Table 4. The choice of the aging time required to produce maximum hardness was made on the basis of experimental time-hardness curves determined for each alloy[3]. The microstructures of the alloys after solution heat treatment, quenching and artificial aging are shown in Fig. 7-9. The photomicrographs show massive, high-temperature, equilibrium beta solid-solution in a matrix of beryllium-rich alpha solid-solution. Finely dispersed gamma solid-solution is also found precipitated at the grain boundaries.

The metallography of the binary copper-beryllium casting alloys is quite simple. When the alloys are cast, the first solid to form is an alpha solid-solution deficient in beryllium. As solidification proceeds, the composition of the solid being formed becomes increasingly richer in beryllium. Since solidification proceeds more rapidly than diffusion can take place, a cored structure results. The last liquid to solidify will be rich enough in beryllium, because of the coring, to allow the eutectic reaction to take place. The structure of the alloy then consists of a cored, dendritic alpha solid-solution matrix outlined by a beryllium-rich beta solid-solution.

As the alloy cools to room temperature, the cooling rate is rapid enough to prevent the eutectoid reaction (beta transforming to alpha and gamma) from taking place. The cooling rate, however, is not sufficiently rapid to prevent some diffusion from taking place. In the higher beryllium alloys, casting gives rise to enough diffusion to allow the alpha to become supersaturated. If the castings are cooled to room temperature rapidly, no self-aging takes place. Slower rates of cooling will allow some precipitation of the gamma phase (the

TABLE 3—PHYSICAL PROPERTIES OF CAST BINARY COPPER-BERYLLIUM ALLOYS SOLUTION HEAT TREATED AT 1510 F FOR 15 MIN AND QUENCHED INTO COLD H_2O

Composition, Be, %	Ultimate Tensile Strength, psi	Rockwell Hardness	Elongation, %
2.82	95,000	48G	27
2.61	85,000	29G	24
2.26	75,000	57B	24
2.01	45,000	35B	25
1.78	33,000	20B	—

TABLE 4—PHYSICAL PROPERTIES OF CAST BINARY COPPER-BERYLLIUM ALLOYS SOLUTION HEAT TREATED AT 1510 F FOR 15 MIN AND AGED AT 680 F

Alloy Composition, Be, %	Aging Time, hr	Ultimate Tensile Strength, psi	Rockwell Hardness	Elongation, %
2.82	1	155,000	42C	1
2.61	1	135,000	42C	1
2.26	1	125,000	41C	1
2.01	4	110,000	31C	1
1.78	16	100,000	30C	2

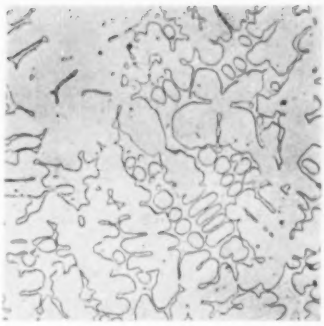


Fig. 4—Cast 96.91 per cent Cu-2.82 per cent Be alloy after solution heat treatment and quenching. Electrolytic etch. X100.

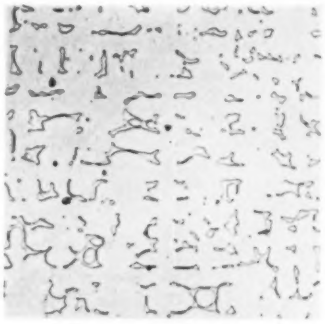


Fig. 5—Copper-beryllium casting alloy (97.48 per cent Cu-2.26 per cent Be) after solution heat treatment and quenching. Electrolytic etch. X100.

Fig. 6—Cast 97.98 per cent Cu-1.78 per cent Be alloy after solution heat treatment and quenching. Electrolytic etch. X100.

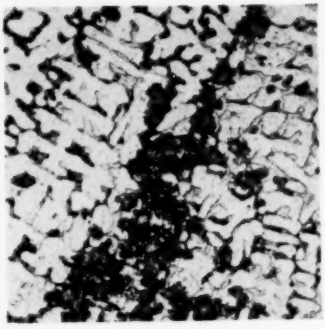


Fig. 7—Copper-beryllium casting alloy (96.91 per cent Cu-2.82 per cent Be) after solution heat treatment, quenching and artificial aging. Acid ferric chloride etch. X100.

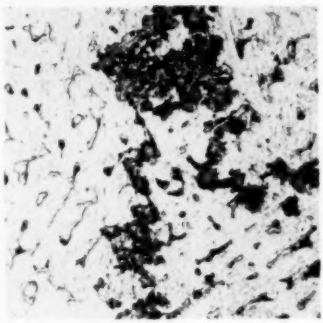


Fig. 8—Cast 97.48 per cent Cu-2.26 per cent Be alloy after solution heat treatment, quenching and artificial aging. Acid ferric chloride etch. X100.

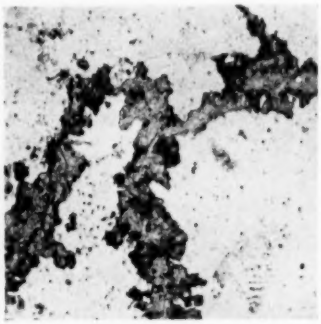


Fig. 9—97.98 per cent Cu-1.78 per cent Be casting alloy after solution heat treatment, quenching and artificial aging. Acid ferric chloride etch. X100.

hardening phase). Prolonged heating of the as-cast alloys at the normal aging temperatures results in the precipitation of the hardening phase.

The heat-treatment of the binary copper-beryllium casting alloys is dependent upon the composition of the alloys and the degree of segregation of beryllium in the alloys. The restrictions imposed upon the temperature of solution heat treatment may be seen by inspecting the equilibrium diagram[3]. If the cast alloy is segregated, the solution heat-treating temperature is limited to the eutectic temperature. Solution heat treating segregated alloys at temperatures higher than the eutectic temperature results in melting of the beta solid-solution.

The alloys investigated all showed segregation and the solution heat treatment was chosen accordingly. Solution heat treatment of the cast alloys modifies the structures. At the solution heat treating temperature, 1510 F, diffusion takes place readily and decomposition of the beryllium-rich beta solid-solution is facilitated. The beryllium diffuses from the beta into the alpha until the alpha becomes saturated, when any remaining beta will tend to spheroidize. Quenching from the solution heat treating temperature gives a theoretically homogenous, supersaturated, alpha solid-solution matrix containing undissolved beta.

Artificial aging of the solution heat treated and quenched casting alloys may be accomplished by heating at an appropriate elevated temperature. The properties obtainable by aging are dependent upon the time and temperature of aging. Maximum hardness and ultimate tensile strength may be obtained by: (a) low-temperature aging (500-600 F) for a long time or, (b) high-temperature aging (600-700 F) for much shorter time. It is generally advisable to use the highest aging temperature possible, provided adequate control of both time and temperature are maintained, because of increased stress relief. In the commercial wrought alloys, the use of high aging temperatures results in better fatigue properties.

Aging and Precipitation

Microstructurally, artificial aging of the casting alloys is evidenced by the visible precipitation of finely dispersed gamma solid-solution at the boundaries and the submicroscopic precipitation of the gamma phase along certain crystallographic planes, viz., the (111) planes of the matrix. If the alloys are examined under polarized light, this preferential precipitation becomes immediately evident. There is no apparent change in the microstructural characteristics of beta solid-solution after aging.

Preparation of specimens for metallographic examination may be accomplished by either mechanical or electrolytic polishing or a combination of both. It was

TABLE 5—ETCHANTS FOR CAST COPPER-BERYLLIUM ALLOYS

Etchant	Etching Time, sec.	Characteristics
Acid Ferric Chloride 5 g. $FeCl_3$ 10 ml conc. HCl 100 ml distilled H_2O	5-10	Poor grain boundary etch, some contrast in alpha; attacks beta avidly, does not attack massive gamma but darkens gamma precipitated at grain boundaries.
Saturated Aqueous Solution of Ammonium Persulfate	20-40	Grain boundary etchant, produces contrast in alpha; etches beta brown, does not attack massive gamma but darkens gamma precipitated at grain boundaries.
Ammonium Hydroxide Hydrogen Peroxide 5 parts 50% NH_4OH 2-5 parts 3% H_2O_2	5-20	Grain boundary etchant, produces contrast in alpha; darkens precipitated gamma; but does not attack beta or massive gamma.
Orthophosphoric Acid (Sp. Gr. 1.71) 1.4 volts	1-5	Etches out beta and massive gamma; not a grain boundary etchant; does not etch gamma precipitated from solution.
1.9 volts	1-5	Etches away alpha leaving other constituent standing in relief, does not etch gamma precipitated from solution.
Concentrated HNO_3	1-20	Etchant used to reveal macrostructures.

found that polishing mechanically, followed by electropolishing at 1.7 volts (anode area = 0.2 sq. in.) using orthophosphoric acid (sp. gr. 1.71) as the electrolyte, gave excellent results. The polished specimens may be etched electrolytically or by chemical methods. The etchants and their characteristic actions are shown in Table 5.

A survey of the data presented shows that the properties obtainable from the binary copper-beryllium alloys are slightly inferior to those of the copper-beryllium alloys containing cobalt and or nickel. The inferiority may be attributed to the large grain size and the uncontrolled grain boundary precipitation in the binary alloys.

References

1. J. K. Smith, "Copper-Beryllium Bronzes," *Transactions*, Institute of Metals Division, American Institute of Mining and Metallurgical Engineers, vol. 99, 1932, p. 767.
2. J. T. Richards, "Beryllium-Copper," *Materials and Methods*, vol. 31, April 1950, p. 75.
3. J. T. Richards, "Designing with Beryllium-Copper Casting Alloys," *Materials and Methods*, vol. 30, Sept. 1949, p. 70.
4. V. D. Hildebrandt, "Heat-Treating Characteristics of Five Binary Beryllium-Copper Alloys," Thesis, Michigan State College (1946).
5. *Metals Handbook*, 1948 Edition, American Society for Metals, Cleveland, p. 1176.

Launch 1951 A.F.S. Apprentice Contest

OPENING SEPTEMBER 15 will be the 28th A.F.S. Apprentice Contest, open to all apprentices taking regular training courses of not less than three years' duration and who are not over 24 years old on the day they prepare their entries. For veterans the age limit is 24 years plus the length of service in the Armed Forces.

As in last year's contest, there will be five divisions —Metal Patternmaking, Wood Patternmaking, and Gray Iron, Non-Ferrous and Steel Molding. Patterns for the molding divisions and blueprints for Wood Patternmaking are supplied through A.F.S. Headquarters. For Metal Patternmaking, blueprints and rough aluminum castings will be supplied.

Contest entries will be judged early next April and prizes of $100, $50 and $25 will be awarded to winners of each contest division. First prize winners will receive round trip Pullman fare to and from the 1951 Convention in Buffalo, N. Y.

Further information is available from J. E. Foster, A.F.S. Headquarters, 616 S. Michigan, Chicago.

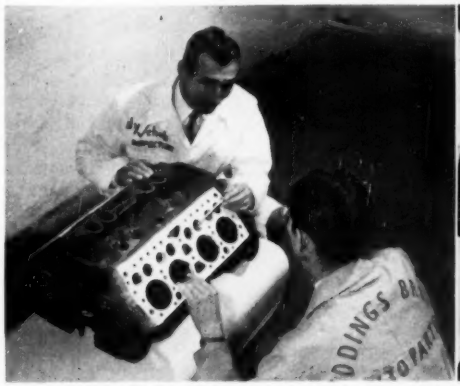
Plan Al & Mg Casting Design Manual

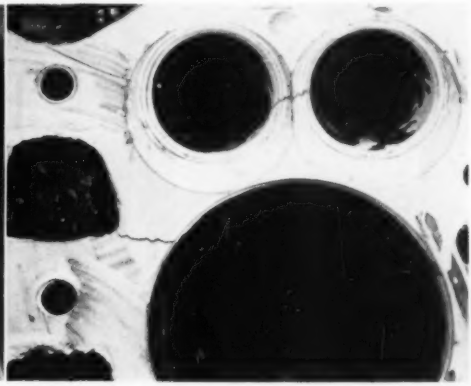
FIRST DRAFT of a proposed new Design Manual for aluminum and magnesium castings is expected to be completed by early November of this year by the A.F.S. Aluminum & Magnesium Division's Design and Stress Analysis Committee, headed by C. E. Nelson, Dow Chemical Co., Midland, Mich.

Planned as a guide to aluminum and magnesium casting design, the proposed volume will emphasize "down to earth" casting design procedures and will serve equally the small and large foundry.

When completed, the Design Manual will include sections on designers' problems, procedure for procuring castings, service requirements, materials selections, obtaining optimum shape, metallurgical considerations, case histories and stress analysis.

New Dye Inspection Method Reveals Defects In Castings





A new metal inspection process, applicable to both ferrous and non-ferrous castings, utilizes a dye penetrant to reveal cracks and microscopic flaws in castings. Developed and marketed by Turbodyne Corp., a subsidiary of Northrop Aircraft, Inc., the Dy-Chek process depends upon controlled use of a red dye and other liquids which when painted on suspected metal cause cracks and other openings to "bleed" in telltale scarlet lines against a white background. Applicable to mass production inspection, Dy-Chek can also be used to examine parts without removing them from motors. Portable and easily applied, this penetrant can readily be utilized by any foundry inspector or skilled mechanic.

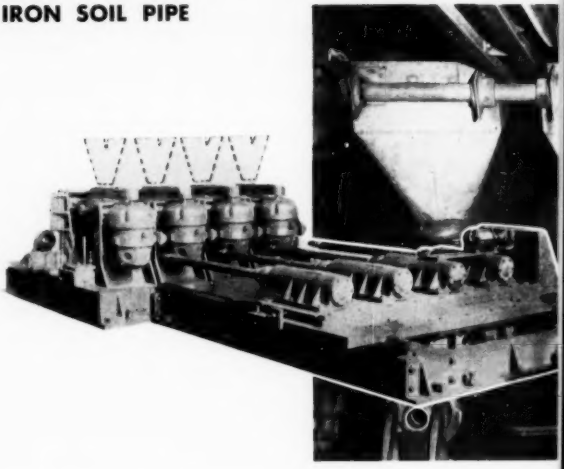
MODERN FOUNDRY METHODS...

AUTOMATIC MACHINE MOLDS AND CASTS IRON SOIL PIPE

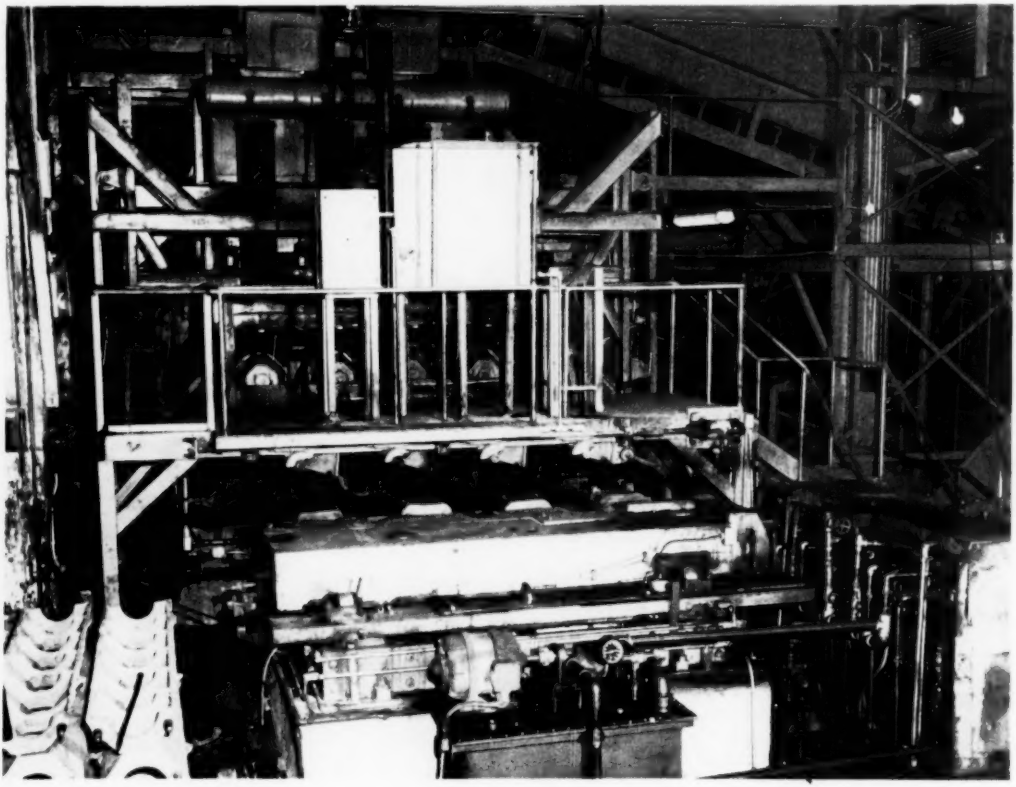
Cast iron soil pipe is produced by a completely new process at the Chattanooga foundry of Combustion Engineering-Superheater, Inc., New York. Hand ramming is eliminated in the almost fully automatic cycle of 42 operations carried out in 25 timed sequences. Centrifugal force, which forms the pipe when the molten iron is poured, also gives the mold its preliminary shape. Molds are finished by a mandrel bearing against the mold wall which compacts the sand and controls the outside diameter of the pipe by governing the mold cavity diameter.

Four molds are produced simultaneously in each cycle of approximately two minutes. Hourly production is 100 or more lengths of 5-ft pipe. A cycle starts with the four empty flasks hydraulically tilted at 45 degrees to receive conditioned sand brought on conveyor belts to the four hoppers. Filled with sand the flasks are rotated to the horizontal position where the ends are covered by caps to keep sand in the flask during the preliminary spin.

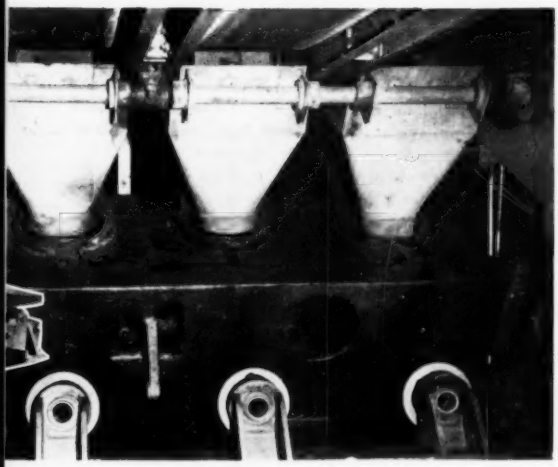
The preliminary spin forces the sand loosely against the cylindrical flask and opens a roughly tubular hole through which the mandrels pass. Pilot bearings in the end caps help control mandrel position. Molds are in-



With flasks atilt, conditioned sand from overhead hoppers pours in to start mechanized molding cycle. Overall rear view of automatic pipe molding unit.



...MODERN FOUNDRY METHODS

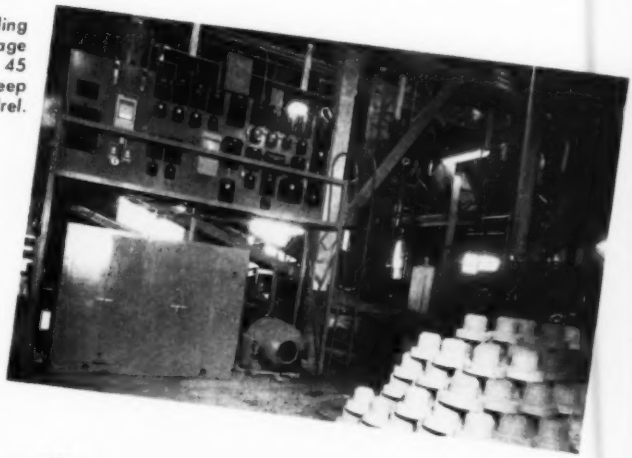


dividually powered. First spinning is at 1000 rpm which is reduced to 600 rpm when the free-running mandrel is moved off center to further compress the sand and finish the mold. Dry sand cores to form the bell of the pipe are positioned by hand after removal of the mandrels, and with the speed raised to 850 rpm, the iron is poured.

A precisely and automatically weighed amount of metal is poured by hand from a monorail ladle into the spinning molds at the end opposite the mandrels, using four tilting reservoirs. In 30 seconds the pipe has "set up," the molds are tilted to a vertical position and plungers push the pipe and sand onto a conveyor under the floor which brings them back to the shakeout at the first floor level. Breakage of the red-hot pipe as it is pushed from the molds onto the apron conveyor is prevented by a layer of sand kept on the conveyor.

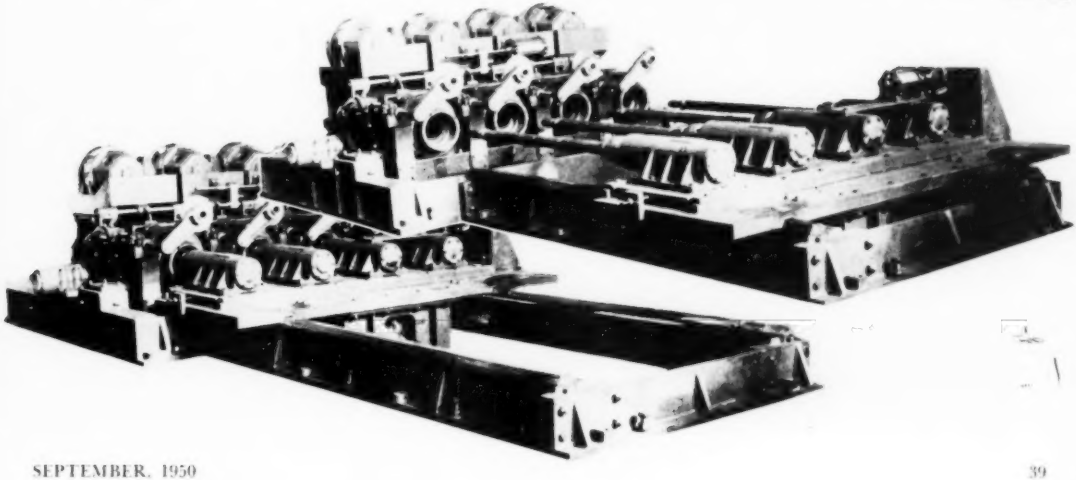
The standard shakeout equipment, with hood for dust and fumes, separates the sand which falls through the grating onto a return conveyor belt to the sand con-

Close-up of hoppers which fill flasks with molding sand. Overhead conveyor belts bring sand from storage hopper and feed it into flasks which are tilted at a 45 degree angle. Pilot bearings in foreground help keep sand in flask during spinning and shaping by mandrel.

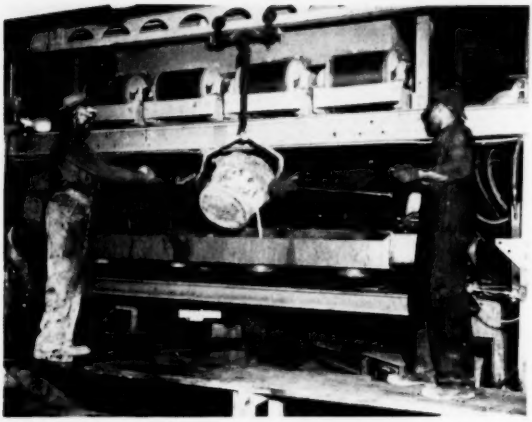


Automatic control mechanism for centrifugal molding and casting machine with part of sand handling and conditioning equipment in the background. In right foreground are hub cores which are inserted before pouring.

View from non-pouring end shows flasks horizontal and ready for preliminary spin (upper) to form rough mold. Mandrels enter flask (lower), engage pilot bearings at opposite end, and move off-center to make the smooth mold face.



MODERN FOUNDRY METHODS...



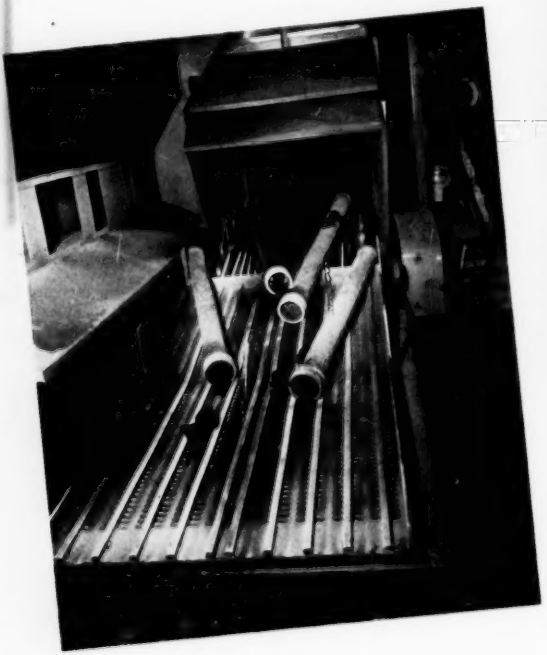
▲ *Metal to pour four pipe simultaneously is received in reservoirs over which a gas flame plays to minimize temperature loss and oxidation. Tilting the reservoirs fills the molds as the pipe is cast at a speed of 850 rpm.*

ditioning and storage unit. Pipe pass over the grating where hub cores and most of the sand are removed. Taken from the shakeout, the pipes are weighed and measured to make sure they meet requirements and are then transported to the cleaning room for finishing, final inspection, and coating with tar if that is specified.

The precision cast pipe requires no annealing. It has uniform thickness and is concentric, enabling it to be cut with a pipe cutter much in the same manner as steel pipe. Wall thickness and inside diameter are dependent on weight of metal poured. This is controlled automatically within five per cent by a device developed by Combustion Engineering-Superheater engineers.

Most popular size of pipe produced on the new automatic equipment is the 40-lb, 4-in. ID pipe. Diameters as small as 2 in. can be cast with the present facilities.

Bell or hub cores and much of the adhering sand are removed as the pipe traverse the shakeout grate on the casting floor level after being knocked out onto an apron ▼ *conveyor which catches the castings at a lower level.*



▲ *Shakeout sand returns to storage via belt conveyor and bucket elevator. With some 75 tons in the system, the sand is conditioned in a three-quarter ton mixer to produce carefully controlled properties. Approximate properties, checked by sand testing instruments kept near the sand unit, are: moisture, just under five per cent; green compression strength, 16 psi; green permeability, 96; flowability, 70; A.F.S. grain size, 57.*

French Foundry ⚜ ⚜ ⚜ CASTS CHAIN CENTRIFUGALLY

Robert Ronceray, President
Ph. Bonvillain & E. Ronceray
Choisy Le Roi, Seine
France

Fig. 1—Cluster of chain as it comes from the mold. Assembled mold ready for spinning and casting at right.

PRECISION CAST STEEL CHAIN is made by a molding method recently perfected by the French firm of Bonvillain-Ronceray which specializes in foundry equipment and hoisting apparatus. Object in developing the technique was to produce chain possessing high mechanical properties with a minimum section size to secure a better factor of safety with reduced weight. At the same time, it was desired to obtain perfect links thus eliminating rough and badly made welds. The process described produces almost 11 feet of chain in a single mold. Link characteristics are: diameter, 0.365 in.; length, 1.75 in., width, 1.225 in. As cast, the chain appears in the form of a cluster as shown in Fig. 1. The mold, made entirely of cores assembled and ready for casting centrifugally, is shown at the right in Fig. 1. Height of the main cluster as well as the diameter is 7.8 in., with the chain distributed in 16 vertical rows of seven links, joined above and below by eight horizontal links, to make a total of 128.

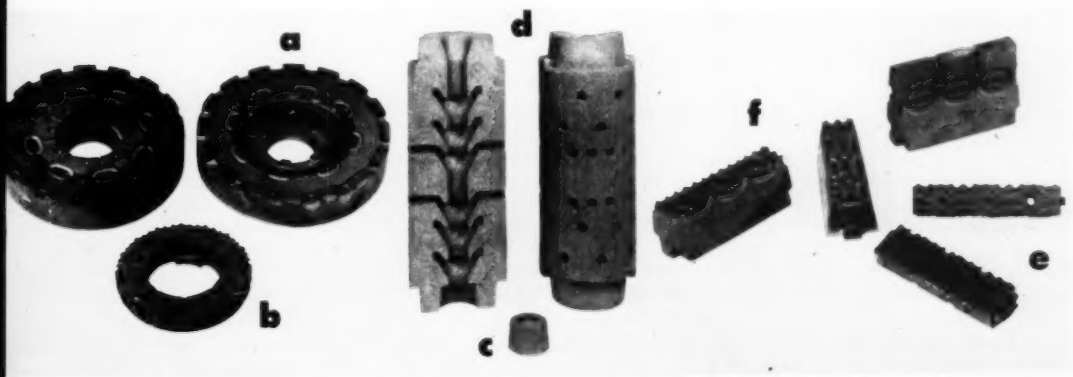


Fig. 2—Views of the six different types of precision cores used in producing centrifugally cast chain.

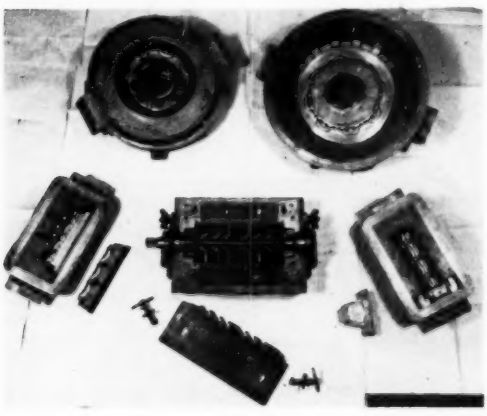


Fig. 3—Core boxes for cast chain are easily repaired, produce cores with flat sides needing no driers.

The sprue occupies the vertical axis of the cylindrical cluster and the gating system, adopted after experimentation, is the "umbrella" type. Each link is fed individually from gates radiating from the sprue.

Thirty-nine cores (Fig. 2) are assembled to make a mold. Needed are two each of cores *A* and *B*, one of core *C*, two of *D*, and 16 each of *E* and *F*. Most of the cores can be easily blown and production time is re-

Fig. 4—Register marks on the 39 cores needed to produce the chain mold make assembly rapid and precise.

Fig. 5—Intricate, vermiform mold cavity and gating system can be seen in the partly assembled core mold.

duced to a minimum. They are turned out on perfectly flat plates and the assembly of the finished cores is made with a precision of around 0.004 in. Figure 3 shows the core boxes and Fig. 4 shows the 39 cores, some partly assembled, ready for final assembly.

Guide Marks Speed Mold Assembly

In assembly, molders follow guide marks formed in the cores by the boxes to achieve precision and speed. First a core *A* is placed flat in the center of the circular tray of the centrifugal machine. Core *B* follows to form the bottom of the mold and the lower circle of eight links. Core *C*, forming the lower part of the sprue, and the two half-cylinders, *D*, are placed to complete the sprue.

Around the sprue cores, 16 of core *E* are positioned, while a second row of 16 (core *F*) complete the cylinder. The mold, with some of the outer cores and half the sprue core removed, is illustrated by Fig. 5. The mold is completed when capped by a pair of cores, *A* and *B*, identical with those used on the bottom of the mold.

Banding the mold, (Fig. 1), and topping it with an upper circular plate held in place by four stay bolts makes the mold able to resist the force of the molten metal during centrifugal casting.

The cast cluster weighs 22 lb, about 13.25 of which is chain, the remainder sprue and gates. If the operation has been carried out well, no fin appears on the casting. Only the lines of the joints are barely perceptible, and these are removed completely in the heat treatment which follows. Cleaning of this precision-cast cluster consists entirely of separating the gates from the links with a cutting disc.

Industrial Arts Fair Features Student Castings And Patterns

Included among top individual entries in the 1950 Ford Motor Co. Industrial Arts Fair, pictured above on display at the Museum of Science and Industry, Chicago, is a bevel gear casting pattern, winner of first prize in the Patternmaking Division of the Fair. Open to students of industrial arts and vocational classes in all schools from grades seven through twelve, the Fair attracted some 2,340 student competitors for cash prizes totaling $13,000 in eight general divisions and 19 classifications, including molding and patternmaking, metal work, woodwork, mechanical drawing and many others.

DESULPHURIZING GRAY CAST IRON WITH MAGNESIUM

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THE QUESTION OF DESULPHURIZATION of cast iron has become increasingly important over the past 10 years, due to generally increasing sulphur contents of the fuels available. In many cases the importance of the sulphur content of cast iron has been seriously overemphasized, and the time is not too far past when sulphur was regarded as the source of most metallurgical difficulties in cast iron. This led to the idea that the lower the sulphur content the better the iron, a concept still held by some, with resulting expensive attempts to obtain very low sulphur contents.

In general, this view has been modified, and for most cast irons there seems little point in obtaining sulphur contents below about 0.08 per cent when the added cost of so doing is considered. It is assumed, of course, that in all cases sufficient manganese is present to combine entirely with the sulphur present.

Meet Sulphur Specifications

However, relatively high sulphur contents of fuels and charge materials now obtainable make the meeting of even an 0.12 per cent maximum sulphur specification difficult at times without ladle desulphurization. Soda ash, and to a much lesser extent caustic soda, are being widely used as desulphurizing agents and, although low in material cost, are erosive on ladle linings, cause objectionable fume, and create a removal and disposal problem of a very fluid, corrosive slag.

The true cost of desulphurizing with soda ash is several times the cost of the actual chemical used, due principally to increased lining costs. However, at present the soda-ash process is widely used, is effective, and is apparently the lowest in over-all cost of available methods.

The advent of nodular irons, made by the addition of magnesium or cerium to cast iron, has not only emphasized the question of desulphurization of cast iron but has opened new avenues of approach to the problem. It has been well known for some time that the alkali metals, such as sodium, calcium, and magnesium, form stable sulphides and will act as effective desulphurizers of molten iron, but in the past the cost has been prohibitive and the sodium reaction became important only through the use of soda ash (sodium carbonate).

Object of Work

It is the purpose of the study reported in the following to investigate the desulphurizing action of ladle additions of magnesium or magnesium alloys, apart from any question of formation of nodular graphite. It will be found that the results will be of interest both to gray iron foundrymen and to foundries making nodular iron. The paper shows how much desulphurization can be accomplished with the limitation of a maximum residual magnesium content of less than 0.02 per cent.

The cast iron used was melted in a 500-lb capacity induction furnace from charges consisting of typical proportions of pig iron, steel scrap, cast iron scrap, and returns. Sulphur was added to the furnace as powdered sulphur in necessary amounts. The chemical compositions of the resulting irons were in the range 3.30 to 3.50 per cent carbon and 2.30 to 2.80 per cent silicon, except where specifically noted otherwise.

TABLE 1—IRON-SILICON-MAGNESIUM ALLOY

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.330	0.100	0.284	0.005	13.9	nil
0.330	0.301	0.190	0.008	42.4	nil
0.165	0.094	0.117	0.011	29.1	nil
0.165	0.208	0.074	0.029	55.1	nil
0.165	0.312	0.035	0.016	78.7	nil
0.165	0.416	0.017	0.031	89.6	80-90
0.136	0.076	0.105	0.005	22.8	nil
0.136	0.136	0.078	0.012	42.6	nil
0.136	0.190	0.070	0.013	48.5	nil
0.136	0.280	0.032	0.014	76.5	nil
0.100	0.097	0.073	0.005	27.0	nil
0.100	0.176	0.053	0.010	47.0	nil
0.056	0.052	0.051	0.007	9.1	nil
0.056	0.104	0.031	0.007	44.6	nil
0.056	0.172	0.022	0.017	60.7	nil
0.056	0.213	0.013	0.018	76.9	30-50

NOTE: These results are plotted in the graph (Fig. 1).

The charge was melted and heated to 2700 F, and tapped in 100-lb portions into a 150-lb capacity ladle. Additions were made by sprinkling the additive by means of a spoon onto the stream of iron filling the ladle, starting as soon as the bottom of the ladle was covered and finishing when about three-quarters full of iron. The ladle was then skimmed, weighed, and test bars poured. All additions of magnesium alloys were in the form of crushed alloy minus ½-in. mesh, except where otherwise noted.

Test bars were analyzed chemically, the magnesium content by the wet, mercury-cathode method (J. A. Fournier and A. E. LaRochelle, "Magnesium and Iron Determined by Mercury Cathode Method," AMERICAN FOUNDRYMAN, Jan., 1950, p. 65), and the sulphur content by the combustion method. All bars were examined metallographically for graphite form and distribution, and for non-metallic inclusion content. All temperatures noted were determined by means of a platinum, platinum-rhodium thermocouple in a silica sheath.

Iron-Silicon-Magnesium Alloy: The first series of runs involved the use of iron-silicon-magnesium alloy, also called magnesium ferrosilicon, containing 8 to 10 per cent magnesium. Data on heats tapped at 2700 F

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TABLE 2—IRON-SILICON-MAGNESIUM ALLOY—EFFECT OF IRON TEMPERATURE

Tapping Temperature, F	Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
2800	0.126	0.204	0.089	0.008	28.4	nil
2700	0.126	0.204	0.063	0.011	50.0	nil
2600	0.126	0.178	0.064	0.012	49.1	nil
2500	0.126	0.172	0.063	0.008	50.0	nil

are given in Table 1. The effect of tapping temperature on the desulphurization process is shown in Table 2.

It is evident that the desulphurization is considerably more efficient at 2700 F than at 2800 F, but that further decrease in tapping temperature results in small increase in efficiency. This point is important, since 2700 F is about the minimum tapping temperature generally used in commercial gray iron foundries. There was little difference in violence of reaction at different tapping temperatures, with possibly more spitting and popping at lower temperatures. The slag or scum formed as the result of the desulphurizing reaction became more viscous and sticky as the tapping temperature decreased.

It is important to note that throughout the series using iron-silicon-magnesium alloy, the reaction in all cases was relatively quiet, and easily applied without concern to commercial operations. A fairly bright white flare was produced, and a moderate amount of white smoke, but considerably less flame and smoke than when the larger amounts needed for complete nodulization are added.

Ladle Linings not Affected

The slag formed as reaction product was not a liquid slag, nor a dry powder, but rather a sort of mush. This slag was easily and completely skimmed from the iron. The slag was mushier and less dry as the initial sulphur content of the iron increased. The effect on ladle linings was so small as to be unnoticeable after more than 200 heats.

The effect of time of holding in the ladle after reaction is shown in Table 3. In this case a 500-lb ladle was filled from the furnace with iron of 0.141 per cent sulphur content, iron-silicon-magnesium alloy to the amount of 0.211 per cent magnesium being added to the stream. Reaction on addition was quiet, more so than with a 100-lb ladle. The ladle was held as long as practicable, samples being poured from the ladle at intervals.

Tapping temperature was 2700 F, iron temperature in the ladle after reaction and skimming 2550 F, and after 19 min holding, 2270 F. A small amount of dry, crusty slag formed on the surface of the iron during holding, which was kept pushed to the back of the ladle. A sample of this slag was taken, presenting when broken cold a grayish-white fracture, very similar in texture to granulated sugar. Chemical analysis showed a predominantly alumina and silica composition.

It is seen that the sulphur content decreased very little beyond that obtained immediately after filling of the ladle, and that there is no point in holding a ladle in hope of further desulphurization. The reason for this is evident in the residual magnesium contents found, the value immediately after reaction being sufficiently low that little further formation of magnesium sulphide can occur.

The effect of the method of adding the magnesium alloy to the iron is shown by the results in Table 4, and their comparison with the results for similar initial sulphur contents in Table 1. In this series the alloy was all added to the bottom of the empty ladle before filling, or was added to the surface of the iron in a full ladle and stirred in.

The reaction on tapping the iron onto the alloy in the bottom of the ladle was quiet, with the efficiency very similar to that obtained when adding to the stream. Addition to the surface of the iron and stirring in creates a more active reaction, is less desirable mechanically, and as would be expected is less efficient. There is a scope for much more work on the effect of method of addition, in order to increase recovery and efficiency with resulting decrease in cost, but in the present study the principles involved were a primary consideration, and uniformity of method of addition was important.

The effect of the particle size of the alloy additions

TABLE 3—IRON-SILICON-MAGNESIUM ALLOY—EFFECT OF HOLDING IRON IN LADLE

Time Held in Ladle After Skimming, min	Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
2	0.087	0.005	38.3	nil
4	0.085	—	39.7	nil
8	0.084	—	40.4	nil
16	0.084	—	40.4	nil
20	0.082	0.001	41.8	nil

TABLE 4—IRON-SILICON-MAGNESIUM ALLOY—EFFECT OF METHOD OF ADDITION

Method of Addition	Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
Bottom of ladle	0.098	0.082	0.074	24.5	nil
Bottom of ladle	0.098	0.181	0.045	54.1	nil
Bottom of ladle	0.181	0.121	0.126	30.4	nil
Bottom of ladle	0.181	0.234	0.083	54.1	nil
Top of ladle	0.106	0.148	0.074	30.2	nil

TABLE 5—IRON-SILICON-MAGNESIUM ALLOY MALLEABLE IRON

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.200	0.085	0.197	0.008	1.5	nil
0.200	0.125	0.167	—	16.5	nil
0.200	0.186	0.143	—	28.5	nil
0.200	0.254	0.131	0.009	34.5	nil

TABLE 6—IRON-SILICON-MAGNESIUM ALLOY STOVE PLATE CAST IRON

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.082	0.066	0.074	0.005	9.8	nil
0.082	0.149	0.047	0.007	42.7	nil
0.082	0.257	0.021	0.023	74.4	*
0.082	0.445	0.014	0.062	82.9	*

*Some nodular graphite was evident in the 0.021 final sulphur sample, with considerable carbide. In the last sample, all free graphite was nodular, but the sample was largely primary cementite and pearlite.

was determined in a preliminary study, and it was found that very fine powders had lower efficiency of desulphurization. However, this effect was not large, and the increase in efficiency from screening fines out of an as-crushed alloy was not sufficient to justify the cost of the alloy thus discarded. Minimum production of fines during original crushing of the cast alloy would seem to be the practical goal.

To determine the effect of base composition of the iron on efficiency of desulphurization, a 500-lb charge was made up and melted to approximate malleable iron composition: 2.50 per cent carbon and 1.00 to 1.40 per cent silicon. This series was tapped at 2800 F, since for this type of iron higher tapping temperatures must be used commercially. Results are given in Table 5.

Comparison of the results in Table 5 with those in Table 1, taking into account the effect of pouring temperature shown in Table 2, indicates that the efficiency of desulphurization has not been affected by the lower carbon and silicon contents.

To further estimate the effect of charge make-up and chemical composition, a 500-lb charge of stove plate and machinery scrap was melted, heated to 2700 F, and treated as above. The as-melted composition was 3.35 per cent carbon, 2.30 per cent silicon, 0.5 per cent manganese, 0.082 per cent sulphur, and 0.35 per cent phosporus. To avoid the necessity of silicon adjustments for constant final silicon content when using iron-silicon-magnesium alloy, 80-20 copper-magnesium alloy was used, which has the same desulphurizing efficiency as the iron-silicon-magnesium alloy. Results are given in Table 6.

Comparison of these results with those in Table 1 and Fig. 1 shows that the efficiency of the desulphurization reaction is apparently unaffected by the nature of the charge or the chemical composition within normal commercial limits.

Nickel-Magnesium Alloy: A shorter series, similar to that in Table 1, was run using 80 per cent nickel–

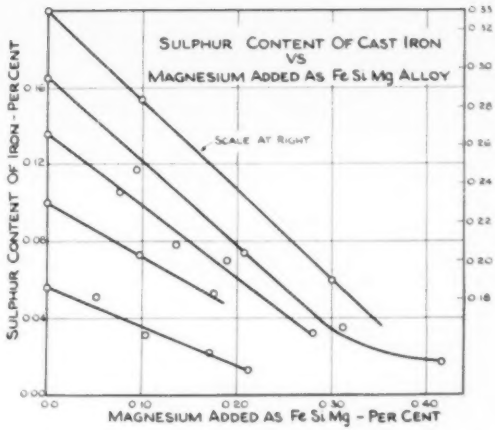

SULPHUR CONTENT OF CAST IRON
VS
MAGNESIUM ADDED AS Fe Si Mg ALLOY
SCALE AT RIGHT
SULPHUR CONTENT OF IRON - PER CENT
MAGNESIUM ADDED AS Fe Si Mg - PER CENT

Fig. 1—Sulphur content of cast iron vs. magnesium added as Fe-Si-Mg alloy. Scale for top curve is at right.

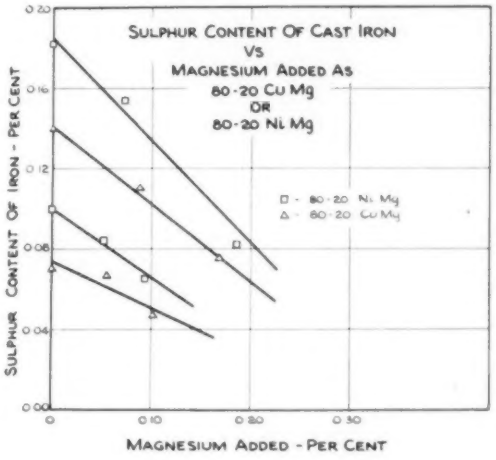


Fig. 2—Magnesium added as 80-20 Cu-Mg or 80-20 Ni-Mg vs. the sulphur content of cast iron (see Tables 7, 8).

TABLE 7—80-20 NICKEL-MAGNESIUM ALLOY

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.100	0.052	0.084	—	16.0	nil
0.100	0.094	0.065	0.011	35.0	nil
0.182	0.073	0.154	—	15.4	nil
0.182	0.187	0.082	—	55.0	nil

TABLE 8—80-20 COPPER-MAGNESIUM ALLOY

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.070	0.061	0.067	—	4.3	nil
0.070	0.102	0.047	0.011	32.9	nil
0.140	0.088	0.110	—	21.4	nil
0.140	0.168	0.075	—	46.4	nil

TABLE 9—50-50 COPPER-MAGNESIUM ALLOY

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.130	0.141	0.110	0.008	15.6	nil
0.130	0.285	0.095	0.012	26.9	nil
0.130	0.590	0.042	0.015	67.6	nil
0.130	1.26	0.017	0.071	86.9	40-50

29 per cent magnesium alloy. Results are given in Table 7. The nickel content of the resulting irons was not determined, but 0.25 to 0.90 per cent nickel was added and would be largely recovered. Reaction was satisfactorily quiet, and the slag formed was easily skimmed clean. The data in Table 7 are plotted in Fig. 2.

Copper-Magnesium Alloys: The series described for nickel-magnesium alloys was repeated using 80-20 copper-magnesium alloy and 50-50 copper-magnesium alloy. Results are given in Tables 8 and 9, and plotted in Figs. 2 and 3.

The reaction was very quiet with the 80-20 copper-magnesium alloy, the slag being easily skimmed but drier and more granular than with nickel-magnesium alloy. The reaction using the 50-50 copper magnesium

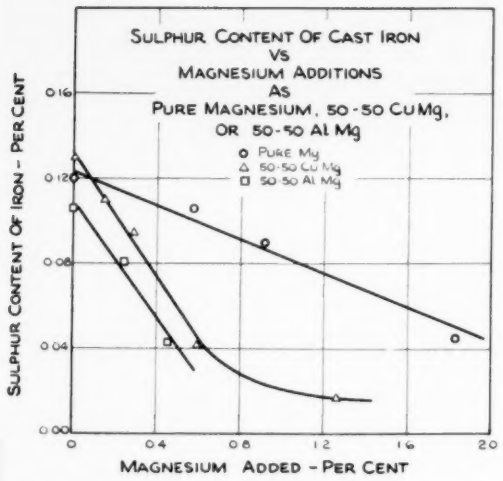


Fig. 3—Sulphur content of cast iron vs. magnesium additions as pure Mg, 50-50 Cu-Mg, and 50-50 Al-Mg.

alloy was considerably more violent. In the case of the sample containing 40 to 50 per cent nodules, the remaining structure was primary cementite and pearlite, with traces of pseudo-flake graphite.

Aluminum-Magnesium Alloy: The 50-50 aluminum-magnesium alloy was similar in reaction to that of 50-50 copper-magnesium alloy, except that the flame was whiter and died more rapidly. The slag on the iron was pasty and easily skimmed, but instantly on skimming a heavy scum formed, presumably largely of aluminium oxide, which was very persistent even throughout pouring operations (Table 10).

Pure Magnesium: The use of pure magnesium wire clippings, 1/8 in. diameter by 3/8-in. length, gave the results shown in Table 11 and Fig. 3. The first result given in the table (not included in the graph) is from addition of the clippings to the stream of iron while filling the ladle. The reaction was violent, and the next three trials were made by adding the clippings to the surface of the iron in a ladle about three-quarters full, through a hole in a loose cover. The violence of the reaction was thus kept to manageable proportions. Although the former method is apparently more efficient in desulphurization, at best the use of pure magnesium in this manner is impracticable. The slag formed was dry and granular.

Metallography: The microstructure of each sample was examined to determine the amount, type, and distribution of both the graphite and the non-metallic inclusions. The changes in microstructure were consistent and formed a well-defined pattern. As the magnesium addition increased (and the residual sulphur decreased), there was a distinct trend to more uniformly distributed, thinner, and shorter graphite flakes. This is a desirable effect, and should result in increased strength and general mechanical properties. This trend was more distinct in the irons treated with the iron-silicon-magnesium alloy, due probably to the additional inoculating effect of the added silicon.

Changes in non-metallic inclusions with addition of magnesium were consistent in all of the samples examined. As magnesium additions increased and the residual sulphur decreased, the manganese sulphide inclusions became smaller and less numerous, and eventually took on a bluish color.

A brownish-black inclusion then appeared, small in size, and increased in number at the expense of the bluish inclusion until all of the inclusions (aside from the usual titanium carbides, etc.) were of the small, brownish-black variety. This inclusion, as nearly as could be determined, is identical with the brownish-black inclusion commonly observed in magnesium-treated nodular iron.

On correlating the appearance of the brownish-black inclusion with the chemical composition of the iron, it was found consistently that it did not appear until the sulphur content decreased to about 0.03 per cent, and was common at about 0.02 per cent sulphur. This change was directly related also to the residual magnesium content, which did not rise appreciably until the sulphur content was below 0.02 to 0.03 per cent. It is believed that this inclusion is predominantly, or entirely, some form of magnesium sulphide.

A qualitative observation that correlates with nodular iron metallography, as observed in these laboratories, is that when the sulphur content becomes low, residual magnesium content rises, and nodular graphite forms, and the quantity of titanium-type carbides and nitrides decreases noticeably. The significance of this observation will be noted in a forthcoming paper.

Discussion of Results

Iron-Silicon-Magnesium Alloy Additions: The experimental points shown in Table 1 and Fig. 1 are remarkable for their consistency, taking into consideration the standard error of chemical determination, and have been found to be regularly duplicable. This is a desirable situation, and from the data in Table 1 a graph was prepared which shows how much of the alloy is necessary as a ladle addition to decrease the sulphur content of the iron by any desired amount. The quantity of silicon simultaneously introduced is also shown on this graph (Fig. 4).

Figure 4 is plotted for a magnesium content of the alloy of about 9.5 per cent, and the lb/ton figures and the silicon introduced will vary slightly with the magnesium content of the alloy and the magnesium-silicon ratio. This graph can be used directly in the

TABLE 10—50-50 ALUMINUM-MAGNESIUM ALLOY

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.106	0.210	0.081	23.6	nil
0.106	0.462	0.043	59.4	nil

TABLE 11—PURE MAGNESIUM

Initial Sulphur Content, %	Magnesium Added, %	Final Sulphur Content, %	Residual Magnesium Content, %	Decrease in Sulphur Content, %	Nodule Formation, %
0.120	0.538	0.090	—	25.0	nil
0.120	0.574	0.106	—	11.7	nil
0.120	0.915	0.090	—	25.0	nil
0.120	1.83	0.045	0.009	62.5	nil

TABLE 12—EFFICIENCY OF DESULPHURIZATION AT 0.20 PER CENT INITIAL SULPHUR CONTENT

Addition Agent	Efficiency, % of Theoretical
Pure Magnesium	5.1
50-50 Aluminum-Magnesium	11.7
50-50 Copper-Magnesium	11.7
80-20 Copper-Magnesium	33.3
Iron-Silicon-Magnesium	33.3
80-20 Nickel-Magnesium	39.5

foundry; for example, if it is desired to decrease the sulphur content from 0.16 per cent to 0.12 per cent, 20 lb of iron-silicon-magnesium alloy must be added per ton of iron, thereby introducing about 0.38 per cent silicon into the iron.

This increase in silicon content must be allowed for, but a useful inoculation effect is coincidentally obtained. As a matter of fact, when introducing 0.3 to 0.5 per cent silicon as an inoculant for cast iron, a sulphur decrease of 0.02 to 0.05 per cent can be obtained simultaneously if iron-silicon-magnesium alloy is used rather than ferrosilicon.

Residual Magnesium End-Point

The lines relating sulphur content and magnesium addition in Fig. 4 were ended where the first trace of nodule formation, with corresponding rise in residual magnesium content, were observed to take place. It will be noted that this end-point rises slightly as the initial sulphur content rises, i.e., nodular graphite formation starts at slightly higher residual sulphur content as the initial sulphur (and the necessary magnesium addition) increases. The reason for this behaviour is not known. Inspection of the data will show that use of the graph as shown in Fig. 4 should result in desulphurization without permitting residual magnesium content to reach or exceed 0.02 per cent.

When the slopes of the lines in Figs. 1, 2 and 3 are plotted against original or initial sulphur content, a graph is obtained that shows the amount of added magnesium necessary to remove a given amount of sulphur. Such a graph, which includes all of the data presented in the foregoing, is shown in Fig. 5. It will be observed that the curves are consistent, with a typical shape. Much can be learned from consideration of this graph.

Assuming the reaction taking place to be one of formation of magnesium sulphide (MgS) whereby 0.75 lb of magnesium will remove 1.0 lb of sulphur, relative efficiencies of the various addition agents may be assessed. At an initial sulphur content of 0.20 per cent, where the lines are becoming horizontal, efficiencies can be calculated, the results of which are given in Table 12.

It is immediately evident that it is useless to consider pure magnesium as a practical desulphurizing agent for cast iron, because of its very low efficiency and its high reactivity. The 50-50 aluminium-magnesium alloy is also considered impractical, not only because it is reactive but because it introduces very undesirable quantities of aluminium into the iron.

Iron-silicon-magnesium alloy and 80-20 copper-magnesium are apparently identical in efficiency, while 80-20 nickel-magnesium alloy is slightly more efficient. From the practical point of view only the iron-silicon-magnesium alloy is of general interest as a desulphurizing agent, since it is reasonably efficient and introduces no alloying elements not already present. It should be noted, however, that if a copper or nickel alloyed cast iron is being made, the use of 80-20 copper-magnesium or nickel-magnesium is an economical means of providing simultaneous desulphurization and alloying action.

It is evident from Fig. 5 that the higher the initial sulphur content the better the desulphurizing efficiency of all the alloys, and it costs much less to decrease the sulphur content from 0.16 to 0.12 per cent than from 0.08 to 0.04 per cent. However, since in cast iron metallurgy sulphur contents below 0.08

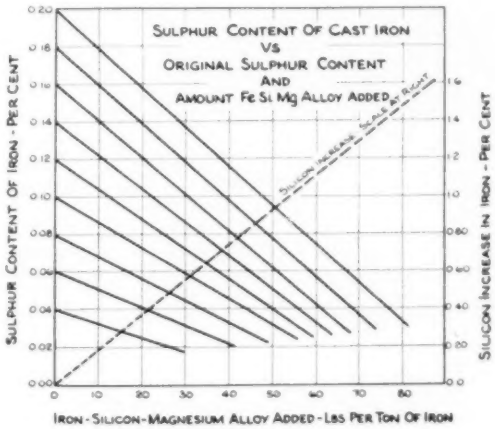

SULPHUR CONTENT OF CAST IRON VS ORIGINAL SULPHUR CONTENT AND AMOUNT Fe Si Mg ALLOY ADDED
SILICON INCREASE SCALE AT RIGHT
SULPHUR CONTENT OF IRON - PER CENT
SILICON INCREASE IN IRON - PER CENT
IRON - SILICON - MAGNESIUM ALLOY ADDED - LBS PER TON OF IRON

Fig. 4—Graph prepared from data of Table 1 showing amount of magnesium additions as Fe-Si-Mg alloy required to decrease sulphur content of iron by any desired amount. Scale for silicon introduced is at right.

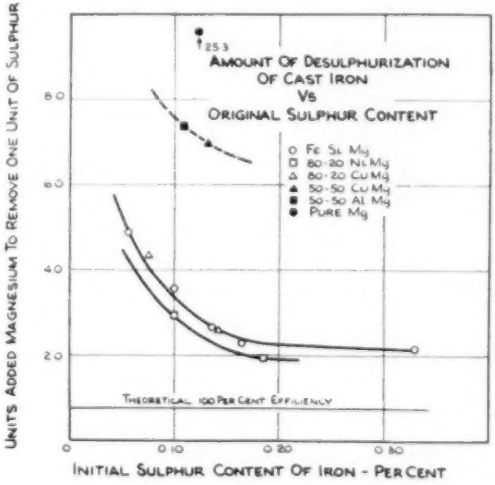

AMOUNT OF DESULPHURIZATION OF CAST IRON VS ORIGINAL SULPHUR CONTENT
Fe Si Mg
80-20 Ni Mg
80-20 Cu Mg
50-50 Cu Mg
50-50 Al Mg
Pure Mg
THEORETICAL 100 PER CENT EFFICIENCY
UNITS ADDED MAGNESIUM TO REMOVE ONE UNIT OF SULPHUR
INITIAL SULPHUR CONTENT OF IRON - PER CENT

Fig. 5—Curves in Figs. 1, 2, and 3 are plotted against initial sulphur contents of irons to show amount of magnesium required to remove given sulphur amounts.

per cent are not usually necessary, the process is of interest chiefly in the region where it is fortunately more efficient. The consistency of the results obtained in this work makes the process technically desirable in the gray cast iron foundry.

From the standpoint of nodular iron metallurgy, the results obtained are instructive. It is believed that the results demonstrate the processes of desulphurization and nodulation to be distinct and separate, nodule formation not taking place until a certain minimum residual magnesium content is obtained or exceeded, this residual amount of magnesium not being obtainable until the residual sulphur content is at a low level. The retention of appreciable amounts of magnesium is coincidental with the replacement of manganese sulphide inclusions by a brownish-black inclusion believed to be a form of magnesium sulphide.

Another point of practical interest to nodular iron metallurgy is that since the desulphurization efficiency of added magnesium increases with increase in initial sulphur content, the saving in cost due to the smaller magnesium alloy additions necessary at lower initial sulphur contents may not be as large as expected.

TABLE 13—ASSUMED ALLOY COSTS

Alloy	Cost/lb
Iron-silicon-magnesium	$0.17
80-20 copper-magnesium	0.40
80-20 nickel-magnesium	0.65
50-50 copper-magnesium	0.35
75 per cent ferrosilicon	0.13½*
Copper	0.16
Nickel	0.39

*Contained silicon.

It will be noted in Fig. 4 that the amount of added magnesium necessary to initiate nodule formation is not proportional to initial sulphur content, an initial sulphur content of 0.04 per cent requiring about 30 lb alloy addition per ton of iron, whereas an initial sulphur content of 0.16 per cent (four times as much) requires about 68 lb alloy addition per ton of iron (little more than twice as much) for initiation of nodulization.

Costs: While the data presented in the foregoing show the technical considerations involved in desulphurization of cast iron with magnesium, the question of the cost of the process is of major importance in determining whether the process is practical in operating foundries, and if not, what changes in prices will make it so.

In determining costs, only the cost of the added alloy will be considered, since the effect on ladle linings is negligible, and the ladles are not delayed by the process, the reaction being complete on filling the ladle. With soda ash, on the other hand, the costs due to decreased lining life usually amount to more than the cost of the added chemical.

It will be evident from the foregoing data that the cost of removing a given quantity of sulphur will depend on the initial sulphur content. The following figures will be for the cost of decreasing sulphur content from 0.16 per cent to 0.12 per cent, but the data are easily re-calculated for other initial sulphur contents and extent of desulphurization. Since other elements are introduced besides magnesium, credits will be allowed for such amounts introduced. Recoveries of silicon from iron-silicon-magnesium alloy are calculated at 85 per cent, copper from copper-magnesium alloy at 85 per cent, and nickel from nickel-magnesium alloy at 90 per cent. Alloy costs were assumed to be as shown in Table 13.

A sample calculation for iron-silicon-magnesium alloy follows:

Alloy required (Fig. 4) = 20 lb/ton of iron
Cost of alloy = 20 × $0.17 = $3.40/ton of iron
Silicon introduced (Fig. 4) = 0.38 per cent = 7.6 lb/ton of iron
Cost of silicon/lb as 75 per cent ferrosilicon = $0.135
Credit value of silicon introduced = 7.6 × $0.135 = $1.03/ton of iron
Net cost of alloy addition for desulphurization = $3.40 − $1.03 = $2.37/ton of iron.

In Table 14 similar figures for other alloys are shown. It is important to note that the figures in Table 14 are dependent not only on initial sulphur content and extent of desulphurization, but on prevailing market prices of the alloy used. With increasing production and use of these alloys, their cost and selling price will probably decrease, and the cost of desulphurization will decrease accordingly.

At present prices desulphurization with magnesium cannot compete on a simple cost basis with soda ash or caustic soda desulphurization, but the spread is sufficiently narrow that decrease in prices of magnesium alloys may make the process economical.

Since iron-silicon-magnesium alloy is apparently the most interesting and practical alloy for desulphurizing cast iron, it may be well to note that if the market price of this alloy were to decrease to about 9¢/lb through larger and more efficient production, the cost of desulphurization therewith, under conditions similar to those in Table 14, would become $0.77/ton of iron treated.

It should be emphasized that the whole question of costs of desulphurizing cast iron with magnesium is open, and the notes immediately above must be considered only as a current framework subject to modification. For example, a change in the method of addition of the alloy that increases the recovery of magnesium will improve efficiency and decrease cost.

Conclusions

From the data presented, it is believed that the following conclusions may be drawn:

1. Cast iron can be desulphurized very rapidly, and with consistent results, by the addition of magnesium-bearing alloys to the ladle.

2. The amount of desulphurization may be controlled so that any desired amount of sulphur may be removed from, or left in, the iron.

3. Provided the final sulphur content is above about 0.03 per cent, desulphurization may be accomplished without exceeding a residual magnesium content of 0.02 per cent.

4. Desulphurization may be accomplished from levels as high as 0.33 per cent sulphur by the use of magnesium, with consistent results.

5. The base composition of the iron with respect to carbon and silicon contents does not appear to have appreciable effect on the efficiency of desulphurization,

TABLE 14—COST OF DESULPHURIZATION WITH MAGNESIUM ALLOYS

Alloy	Cost/ton of Iron
Iron-silicon-magnesium	$2.37
80-20 copper-magnesium	2.80
80-20 nickel-magnesium	2.47
50-50 copper-magnesium	2.98

at least within the limits of 2.50 to 3.60 per cent carbon and 1.00 to 2.80 per cent silicon.

6. The efficiency of the desulphurization reaction decreases with increasing iron temperature, but this effect becomes important apparently only above about 2700 F.

7. The desulphurizing reaction is very rapid, and is essentially complete on filling of the ladle.

8. No deleterious effect on ladle linings is produced by the process.

9. The sulphur content must be decreased to about 0.02 to 0.03 per cent before a residual magnesium content of 0.02 per cent is exceeded.

10. Nodular or spherulitic graphite is formed in increasing quantity as the residual magnesium content reaches and exceeds 0.02 per cent.

11. The appearance of a typical brownish-black inclusion is noted in the microstructure, replacing manganese sulphide, when the sulphur content is such that appreciable residual magnesium is present. This inclusion is believed to be the magnesium sulphide.

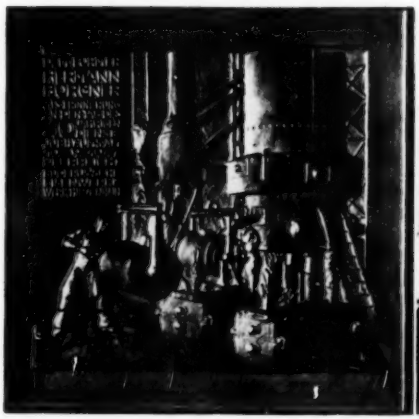
12. The efficiency of desulphurization of cast iron depends on the initial sulphur content, the particular magnesium alloy used, the temperature of the iron, the method of adding the alloy, and the particle size of the alloy.

13. At present prices of magnesium alloys, the desulphurization of cast iron with magnesium is higher in cost than other commonly used methods, but the cost differential is such that possible decreases in magnesium alloy prices may make this process economically advantageous.

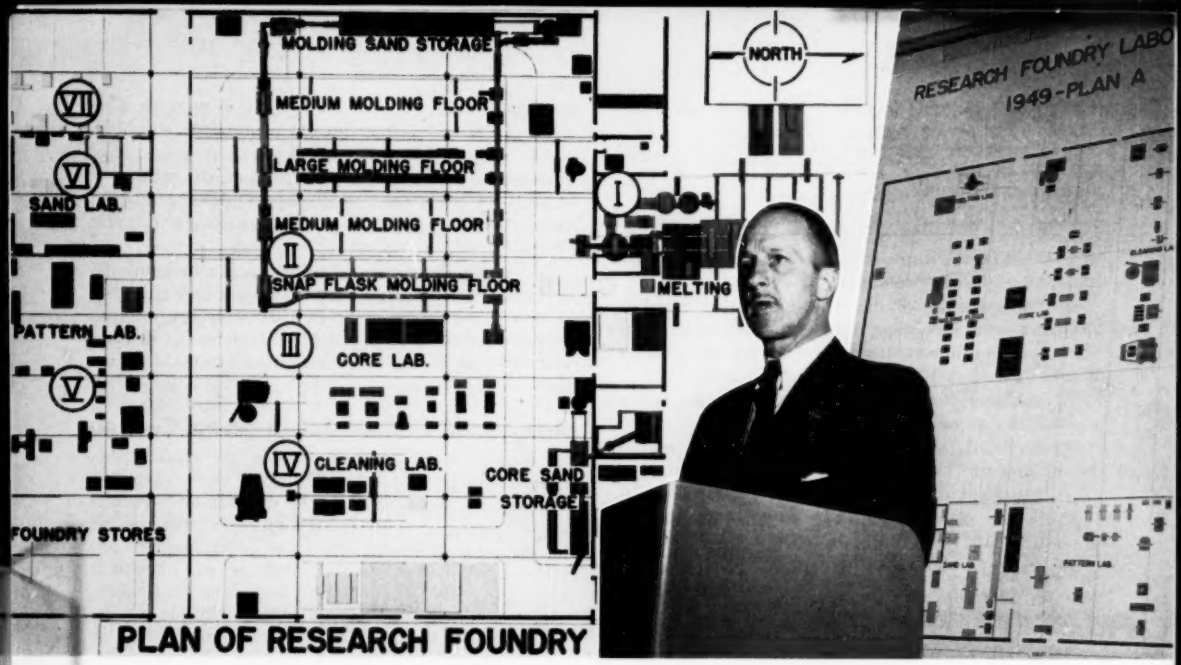
Announce Philadelphia Shop Course

CUPOLA SHOP PRACTICE COURSE of the Philadelphia chapter will be held at the University of Pennsylvania October 11-13 according to H. E. Mandel, Pennsylvania Foundry Supply & Sand Co., chairman of the chapter's Educational Committee. Instructor for two and one-half days will be B. P. Mulcahy, Fuel Research Laboratory, Inc., Indianapolis, Ind. The course ends with a visit to the Philadelphia Coke Co. plant. Mr. Mulcahy will be the Philadelphia chapter's regular meeting speaker the same evening, October 13, at the Engineers' Club. His topic will be "*Cupola Practice.*"

German Art Castings On Display In Muskegon



Recently featured in a week-long display in the window of a Muskegon, Mich., department store was an extensive exhibit of German art castings brought to this country by George W. Cannon, pioneer Muskegon industrialist and foundryman. The castings were first displayed at the 54th A.F.S. Foundry Congress & Show in Cleveland last spring, shortly after Mr. Cannon's return from Europe accompanied by Dr. Franz Grosser, president of the Wetzlar, Germany, firm making the castings. In photograph at left is shown a fine example of German casting art—a plaque awarded each employee of the Wetzlar firm upon completion of 25 or more years of service. At right Dr. Grosser (left) and Mr. Cannon examine a few of the outstanding castings in the exhibit, including a complete cast iron dinnerware service, a series of cast panels (on wall) depicting scenes from Goethe's poem, "The Earl King," and a figurine of St. Barbara, patron saint of German foundrymen, a casting which required some 38 cores and two half-molds.



Harvester Board Chairman Fowler McCormick speaking at opening of new Research Foundry. Behind him at right is plan of foundry as it now is, and at left, plan of foundry as it will be when fully completed.

INTERNATIONAL HARVESTER OPENS $1,200,000 RESEARCH FOUNDRY

TWO-FOLD PURPOSE—improvement of foundry technical knowledge and processes and the training of skilled technicians for the castings industry—marked ceremonies dedicating the first unit of the International Harvester Co.'s new $1,200,000 Research Foundry in Chicago August 15.

Present to witness the pouring of the first mold by Harvester President John L. McCaffrey were top officials of the company, heads of foundry technical and trade societies, university and engineering school officials, and representatives of the technical and trade press.

Principal speaker at a luncheon held in the Manufacturing Research Center's cafeteria preceding the

International Harvester President John L. McCaffrey pours the first mold in ceremonies opening the company's new $1,200,000 research foundry August 15.

(Left) Close-up of the molding area, showing molding machines and finished molds ready for pouring.

pouring ceremony and a tour of inspection was International Harvester Board Chairman Fowler McCormick, who described the new Research Foundry as "the center of original and creative work having to do with the improvement of International Harvester products."

"This department," McCormick continued, "acts as a funnel for scientific and technical information, taking information from both within and without the company, putting it into a condition readily usable by various Harvester operations."

Manned entirely by college graduates, two of whom are shown here pouring molds, the foundry's purpose is to improve technical knowledge and processes and to produce skilled foundry technicians.

To accomplish the foregoing objectives and at the same time fulfill its broader policies of improving foundry technology and processes, International Harvester has staffed the Research Foundry with engineering school graduates who are being trained for foundry, technical, supervisory, and managerial positions. Work of the Research Foundry is under the direction of J. W. Armour, manager of Manufacturing Research, assisted by G. P. Phillips, general supervisor of foundry research, and A. W. Anderson, assistant general supervisor of foundry research.

In addition to the training and development of foundrymen, the Research Foundry is expected to benefit both the company and the foundry industry by developing new techniques for the production of castings, improving foundry working conditions, affording better control of materials and processes, improving casting quality and foundry operations and reducing casting costs.

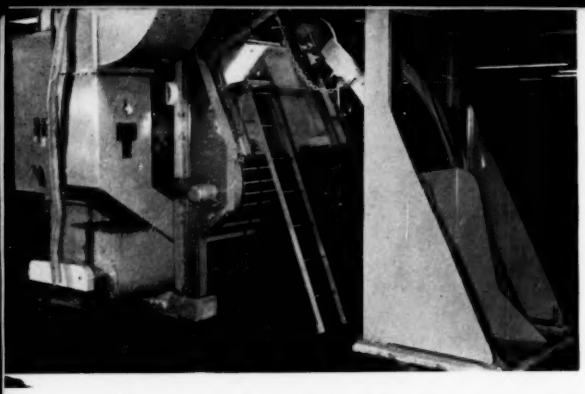
The foundry is housed in the same building with 10 other sections that make up International Harvester's Manufacturing Research Department and is thus in a position to use the facilities and services of related research sections in its own work. For example, additional facilities for checking foundry products are part of the Metallurgical Section and include chemical and physical testing, metallographic and electrical laboratories. Facilities of the welding and machine shop sections are also available to the Foundry Research Section.

Equipment shown (left to right) includes 17 x 8 in. draw, power jolt, hand rollover foot draw core machine; 24 x 8 in. and 30 x 8 in. hand ram, power turnover, foot draw core machines; and coreblower.

Placed in operation with the pouring of the first mold by President McCaffrey on August 15 is the first unit of the two-stage foundry installation. This unit has a melting department equipped with a 1000-lb-per-hour direct arc electric furnace with auxiliary equipment, capable of producing about four tons of melt a day. The remainder of the first-stage foundry

(Above) View of sand laboratory operated in conjunction with International Harvester's Research Foundry showing testing equipment, laboratory tables,

(Below) View of Research Foundry's pattern laboratory. Shown in foreground are, left to right, 16-in. jointer and planer, 16-in. rip saw, cut-off saw,



Research foundry cleaning laboratory is equipped with a 48 x 42 in. blast cleaning tumbling mill.

includes a molding sand preparation unit with various types of molding machines; a core department equipped with a muller, core machines, core blower and core ovens; and a cleaning department with tumbling, shotblasting, and grinding facilities.

A complete foundry laboratory is equipped to run tests on sands, binders, and core mixtures at both room and elevated temperatures. This laboratory also has physical testing equipment for making transverse and tensile plus hardness tests on metal bars and specimens.

A pattern shop for the construction of wood patterns and gating and modification of metal patterns completes existing facilities.

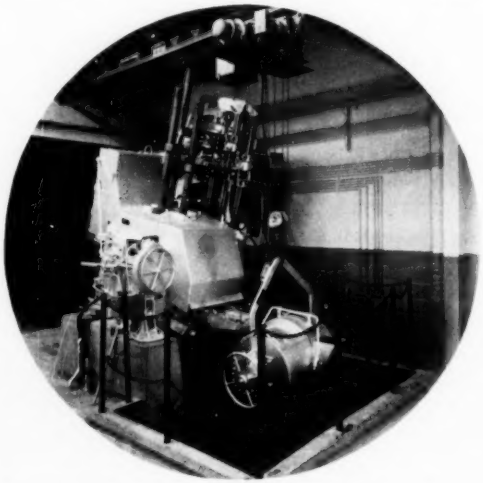
The second stage of the Research Foundry installation began on August 16 and is expected to be completed during the ensuing year. Principal differences between the first stage foundry and the second stage foundry are that a closed top cupola will be added, the foundry completely mechanized and first stage equipment augmented.

Research Foundry's molding sand preparation unit has a capacity of 5 to 6 cu ft per batch of sand.

When the proposed mechanization of the foundry is completed there will be mechanical handling equipment for all raw materials, molten metal, prepared molding sand and core mixes, cores, molds, and castings. An extensive exhaust system already partially installed to cover all points of dust generation will be greatly enlarged in the second stage foundry.

When the entire installation program is completed, the Research Foundry will be equipped to produce experimental castings in practically the entire size and weight range used by International Harvester's operating divisions. Daily melting capacity will be about 25 tons of metal.

When the second stage is completed the Melting Department will have a closed top cupola equipped with automatic air weight control, hot blast equipment, blast moisture control equipment, facilities for adding oxygen to the blast, and the latest in dust and fume suppression equipment. The cupola will have mechanical charging with special buckets for metal and for coke plus flux charges. A "water wash" slag disposal unit will be installed and all raw material storage will be under cover. Charge makeup will be by crane with weight recording scales for all materials. All cupola equipment will have indicating and



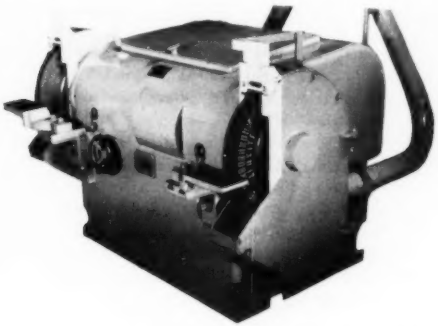
Partially tilted electric furnace has a 1000-lb-per-hr capacity. Ladle is suspended by a 2-ton crane.

recording gages. Molten metal will be delivered to pouring areas by electric truck.

When fully completed, the Molding Department will consist of four molding floors, each served by two bridge cranes, for production of largest molds on jolt machines, down to small molds made on squeezers. Mechanical shakeouts over a sand return belt will serve the four molding floors. Shakeout sand will be returned underground by belt conveyor to a sand storage and preparation unit equipped with magnetic pulley elevators, screen, storage hoppers, weigh larry, and muller. After preparation in muller, the sand will be elevated, aerated, and delivered by belt to overhead sand hoppers.

Cleaning department will contain three types of shotblast equipment—handblast, tumblast, and revolving table. Two tumbling mills are included in the equipment and stationary and portable grinding equipment will be served by cranes or skip hoist loaders. Space is included for annealing equipment to be used in malleable and nodular iron research.

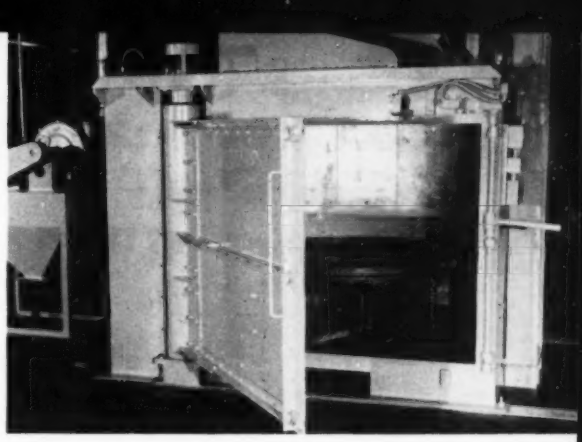
Space now reserved for castings display may eventually be used for installation of an induction melting unit, precision casting equipment, and a metal pattern shop.



Foundry's cleaning room has heavy duty ball snag grinder with two 24-in. diameter x 3-in. wheels.

When the Research Foundry ultimately operates at the peak of its research and training program it will employ approximately 65 people, who will undertake such specific projects as:

Development of gating, risering, pouring rate and time, core mixtures and sand mixtures.



Abrasive cleaning cabinet is equipped with 66 in. diameter table mounted on vertical spindle shaft.

Chemical, physical, and metallurgical examination of castings to insure soundness.

Evaluation and trial of new foundry raw materials.

Research in new molding methods, including mold blowing, vacuum casting, and testing of new molding machine designs.

Research in core making, baking, and properties.

Research in all phases of metal melting, using either or both cupola and electric furnace to determine effects of melting media on metal properties.

Production of higher strength irons, including nodular irons, and research in various heat treatments of cast irons.

Completion of these and other research projects, according to Board Chairman McCormick, will ultimately benefit the entire foundry industry by improving its products and methods, its technology, and by making the foundry a better place to work.

Personnel of International Harvester's Research Foundry, all engineering school graduates (in uniforms) shown with Assistant Supervisor A. W. Anderson (4th left, top row) and President McCaffrey.

DIRECT COLORIMETRIC DETERMINATION OF COPPER AND IRON IN TIN AND LEAD BASE ALLOYS

M. Sherman
Chief Chemist
Silverstein and Pinsof, Inc.
Chicago

RECENTLY A PROCEDURE for the determination of copper in tin- and lead-base alloys was proposed.[1] The copper was determined by its reaction with sodiumdiethyldithiocarbamate. Arsenic, antimony and tin were volatilized with hydrobromic acid and lead was removed after fuming with sulphuric acid.

During the dissolving process with a hydrobromic bromine mixture, the observation was made that after the bromine was driven off the color of the solution gave a rough indication of the copper content of the alloy. Further tests and a literature search proved that the color of hydrobromic acid with copper could be the basis of a simple method for the determination of copper in tin and lead base alloys.

Although the reaction of hydrobromic acid with copper[2] had been known for many years, we were able to find but three quantitative applications [3, 4, 5] of the reaction. One possible explanation might be due to the fact that iron interferes with the reaction. Other elements forming a color with hydrobromic acid are gold and the platinum group elements which need not be considered in the alloys under consideration. The possible presence of a high concentration of colored ions may also be disregarded. Goldschmidt and Dishon[6] claim that bismuth interferes in the spot test for copper; however, we were unable to find such interference under the conditions of the determination.

The common methods for overcoming the interference of iron are the use of phosphoric acid to complex the iron, or taking readings of the colored solution at two different wave-lengths—one for copper, and one for iron. We have found phosphoric acid to be unreliable when substantial amounts of iron are present, and the use of two wave-lengths is not practical when copper and iron are present in disproportionate amounts.

The possibility was then considered of using an independent method for the determination of iron. The use of thioglycolic acid[7] affords a simple and direct method for the determination of iron. None of the elements usually found in tin- and lead-base alloys interferes, and it is thus possible to determine the iron accurately on the same sample on which the copper is determined. In actual practice, iron in refined alloys is usually present to the extent of only a few hundredths of a per cent. Since the color of hydrobromic acid with iron is about one tenth the strength of that with an equal amount of copper at a wave-length of 610 millimicrons, the interference of iron in the majority of cases may be ignored. It is only in drosses and other special alloys where substantial amounts of iron may be expected. In any case, a complete determination for both copper and iron may be completed in less than 10 min. Either element alone may be completed in less than 5 min with an accuracy equal to that of standard methods.

Reagents and Solutions

Standard Copper Solution: Dissolve 0.1000 gram pure copper with 15 ml 1:1 nitric acid. Boil out brown fumes, cool to room temperature, dilute in a volumetric flask with water to exactly 1000 ml, and shake well. On the basis of a 0.1-gram sample, one ml of this solution represents 0.1 per cent copper.

Concentrated Standard Iron Solution: Dissolve 1.0000 gram pure iron with 25 ml 1:1 nitric acid, boil out brown fumes, cool, dilute to exactly 1000 ml and mix well. On the basis of a 0.1-gram sample, each ml represents 1.0 per cent iron.

Dilute Standard Iron Solution: Transfer exactly 100 ml of the concentrated standard iron solution to a liter volumetric flask, dilute to the mark with water and mix well. On the basis of a 0.1-gram sample, each ml represents 0.1 per cent iron.

Hydrobromic Acid-Bromine Mix: To 900 ml hydrobromic acid add 100 ml bromine. Use rubber gloves and prepare the solution under a hood.

Citric Acid—25 per cent: Dissolve 250 grams citric acid with water and dilute to a liter. Add about 0.1 gram thymol as a preservative.

Thioglycolic Acid (Approx. 70 %): A satisfactory

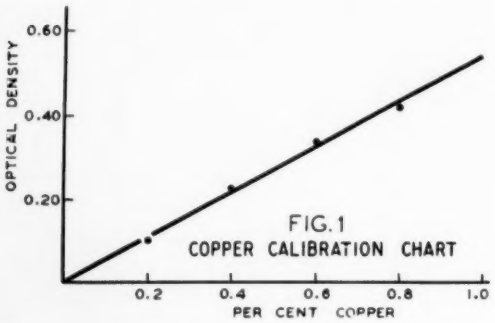


FIG. 1
COPPER CALIBRATION CHART

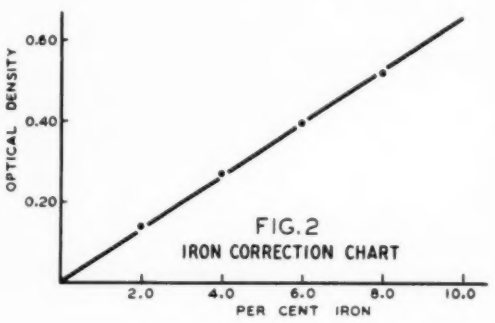


FIG. 2
IRON CORRECTION CHART

grade is obtainable from Evans Chemetics, New York.

Calibration and Preparation of Charts

Copper Calibration Chart: Transfer 0.5, 1, 2,–to 10 ml of the standard copper solution to a series of 125-ml flasks. Heat on the hot plate to dryness. Cool somewhat and add 10 ml of hydrobromic acid-bromine mix to each flask. Boil till no more brown bromine fumes evolve and cool to room temperature. Transfer to graduated matched 20 ml colorimeter tubes, rinsing out the flasks with small portions of hydrobromic acid. Dilute to the mark with hydrobromic acid and mix by transferring back and forth into a small dry flask. Set the zero point of the colorimeter at 610 millimicrons with a tube containing the hydrobromic acid used in the analysis and read the optical density of the solutions. Make a plot of optical density versus per cent copper on rectangular coordinate paper.

Iron Correction Chart: Repeat the exact steps used in the calibration of the copper chart except that concentrated standard iron solution is used instead of standard copper solution. Plot optical density versus per cent iron on rectangular coordinate paper.

Iron Calibration Chart: Transfer portions of the dilute standard iron solution to a series of 100-ml volumetric flasks. Add in order with mixing after each addition: 3 ml citric acid, 10 ml concentrated ammonium hydroxide and 3 ml thioglycolic acid. Dilute with water to the mark and mix. Read density using a 520-millimicron filter and plot vs. per cent iron.

Procedure for Copper

Transfer a 0.1-gram sample to a 125-ml flask and dissolve with 10 ml hydrobromic acid-bromine mix. Proceed exactly as for copper calibration chart.

Procedure for Iron

Transfer the contents of the colorimeter tube from the copper determination to a 100-ml volumetric flask, rinsing out the tube with water. Also rinse out the flask used for mixing the copper solution into the volumetric flask.

Add in order with mixing after each addition: 20 ml 25 per cent citric acid, 30 ml concentrated ammonium hydroxide, 3 ml thioglycolic acid, dilute with water to the mark and mix.

Read the density of the solution using a 520-millimicron filter against a zero set with water. If there is sufficient iron present to necessitate an iron correction, read the corresponding density for that iron percentage on the iron correction chart. Deduct this density from that of the copper density and read off the copper percentage from this net density.

Discussion

Using an 18-mm tube at the specified wave-lengths and sample weight, the range for both the iron and copper is from 0.01 to about 1.0 per cent. For higher copper percentages a smaller sample should be taken or the colored solution may be diluted to contain no more than 1 mg copper per 20 ml. For traces of copper the size of the sample may be increased. For iron over one per cent a portion of the colored solution may be diluted. However, about 10 ml of ammonium hydroxide and 2 ml of thioglycolic acid should be added to the diluted solution.

TABLE 1—ANALYSIS OF U. S. BUREAU OF STANDARDS SAMPLES AND SYNTHETIC STANDARDS BY PROPOSED PROCEDURES

Sample U.S.B.S.	Cu Present	Fe Present	Cu Added, equiv. per cent	Fe Added, equiv. per cent	Cu Found	Fe Found
53a	0.002[a]	0.006[b]			0.003	0.004
53b	0.209	0.002			0.21	—
127	0.014[c]	—			0.013	
54a	3.75[d]	0.041			3.72	0.039
53a			0.30	0.50	0.30	0.49
127				0.10		0.10
127				5.0[e]		5.02
53b	0.209			1.00	0.21	1.00

[a]1.0 gram for Cu determination.
[b]0.5 gram for Fe. Amount of citric acid doubled.
[c]0.3 gram for Cu.
[d]0.05 gram with final dilution to 60 ml with HBr.
[e]Dilution to 500 ml.

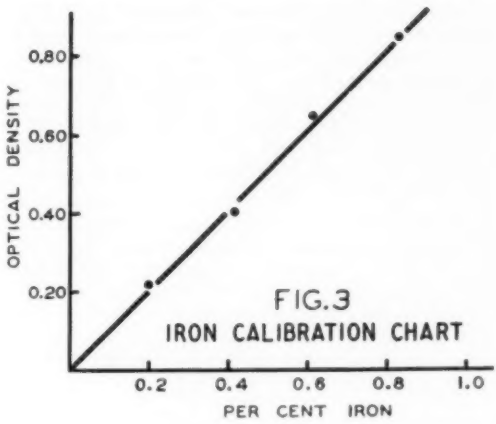


FIG. 3
IRON CALIBRATION CHART

Table 1 shows results obtainable by these procedures on U. S. Bureau of Standards samples. On those samples to which pure copper or iron were added, the solution of the element was first taken to dryness, the standard sample added and the analysis completed by the foregoing procedures. Figures 1, 2 and 3 are plots of the standard copper, iron correction and the iron graphs, respectively.

When iron is present to the extent of only a few hundredths of a per cent and an accuracy to the third decimal place is desired, a larger sample should be run for the iron.

The use of optical density instead of transmittance is recommended for these determinations. All the curves pass through zero and are linear for the ranges specified. Thus, if sample volumes or weights are changed, simple multiplication or division will correct the readings for proper use of the charts.

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3. C. Huttner, *Z. anorg. Chem.* 86, 351 (1914).
4. G. Deniges and E. Simonot, *Bull. soc. pharm. Bordeaux*, 54, 337-40 (1915).
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7. M. Sherman, AMERICAN FOUNDRYMAN, 14 no. 6, 55-6 (1948).

Questions THE ROUND TABLE Answers

Gating and Risering Control

Aside from information published in A.F.S. *Transactions* and *American Foundryman*, which we have, what can you refer us to on the subject of gating and risering? We are in the process of developing a record system for gating and feeding designs for all our patterns so that standards may be established that will improve our operations and also assist us in the design of gates and risers for new jobs.

Thanks to the Gray Iron Division Research Project we now have available a complete bibliography on the gating and risering of gray iron castings, prepared by B. F. Brown and Howard F. Taylor and published recently by the American Foundrymen's Society. This pamphlet is extremely well prepared and should be an excellent guide to anyone setting up production control for gating and risering.

FOUNDRY PRACTICE RECORD Form No. 8

CUSTOMER: PATT. NO.
ORD. NO.
CASTING: DWG. NO.
WEIGHT: YIELD: ANALYSIS:
SECTION: POUR. TEMP:
RIGGING: POUR. TIME:
SAND MIX:

COMMENTS:

DATE RECD: PILOT DATE:

Foundry practice record card provides space for pertinent data on front and color-coded sketch of molding method on back. Actual size of cards is 4 x 6 in.

The mechanics of setting up a shop system to control gating and risering will have to be worked out by each plant to suit its own conditions, but we have found that certain fundamentals work well in all plants. Our system makes use of the foundry practice record card illustrated. The back of the card is blank and is used for a sketch of the casting showing the layout of the gating and risers, dimensions, the location of chills, special precautions to be taken, etc. We have worked out a more or less standard color code in which the sketch is made in pencil, gates and risers are cross-hatched in red, cores are shown in purple, chills are blue, and skim devices are green. The sketch need not be elaborate nor complete to the last detail, but only good enough so that the foreman or molder can reproduce the success with which he made previous castings off the same pattern.

Generally, in our plants the rigging card file is maintained by the metallurgical department and work on it is excellent training for new staff members. Decisions on gating and risering are made at a morning meeting in the pattern layout room with the foreman and the metallurgist attending. The core room foreman, the production manager, the engineering department, and others are called upon as needed, but the whole affair is over usually in less than half an hour. In that time decisions have been made on new jobs, outstanding scrap has been looked at and criticized, and shop follow-up is set to be carried on by both the foreman and the man in charge of the rigging card file.

N. A. Birch, *Div. Metallurgist*
National Bearing Div.
American Brake Shoe Co.
Meadville, Pa.

Needs Bell Design Information

Where can we get information on how to design cast bells to achieve certain pitches and tones?

Literature on this subject does not seem to be available and we have had no personal experience with bell casting. American Foundryman reaches all types of foundrymen and those familiar with bell casting are invited to reply to the question above for publication in "The Foundrymen's *Own* Magazine."

URGENTLY NEEDED

VOLUME 56 (1948) TRANSACTIONS

Bound copies of this volume in good condition will be purchased by A.F.S. Headquarters. Members who have no further use for their copies are urged to write The Secretary, American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5.

400-YEAR OLD BELGIAN FOUNDRY

Robert Doat
Engineer
Compagnie General des Conduites D'Eau
Vennes, Liége, Belgium

PRODUCTION of low-silicon, thin-section cooking utensils was practiced early in the history of the 400-year old Vennes foundry, using an analysis which normally today would produce white iron. Founded October 13, 1548, in Liége, Belgium, by the Compagnie General des Conduites d'Eau, the foundry also produced heavy castings and during the Revolutionary War supplied cannon and cannon balls to the forces of the Thirteen Colonies.

At the time of the founding of this plant the small leather bellows operated by hydraulic wheels were not powerful enough to produce, in the small charcoal and cold air blast furnaces of the period, temperatures capable of greatly reducing the silica in the iron ore. Accordingly, the castings produced in the 16th century contained only 0.4 to 0.9 per cent silicon, with total carbon of 3.4 to 4.4 per cent; these castings ordinarily were white in thin sections and even in those of medium thickness.

The more massive pieces were mottled or somewhat gray and had good strength. That is why the Vennes foundry was able, from the 16th century, to make excellent cast iron cannon. For example, in 1575 this foundry delivered to Spain in 5 months 300 cannon and 46,000 balls, that is, 620 tons of castings. This was considerable tonnage for that period, especially since these cannon were the first cast in Liége.

In the following centuries the foundry continued to cast cannon and cannon balls for the country, for the neighboring countries, and even for the United States. In fact, during the war of Independence numerous cannon were cast for the Americans. A Belgian writer, the Baron of Dorlodot, is at this time preparing a well documented and exciting book on the supplies of heavy and light arms furnished by the Belgians to the Americans fighting for their independence.

Cast Cannon From Reverberatory Furnace

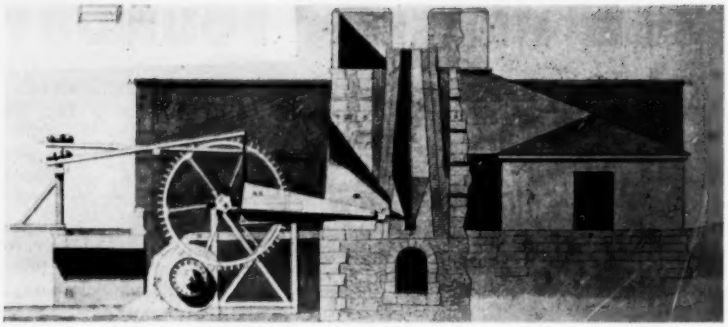
Among the supplies of the Vennes foundry to the Americans we find, for example, an undetermined number of cannon at the beginning of 1779, five hundred sixty cannon at the end of 1779, two hundred twenty-five tons of cannon in 1782, etc. The first of these supplies was shipped through a French port, and the other two through Dutch ports. Various roundabout routes were used to evade the British fleet which was trying to establish a blockade.

After the 16th century the dimensions of the blast furnaces and the power of their bellows increased and, in the 18th century, the castings became gray with a silicon content up to 1.5 per cent. The cannon furnished to the Americans in the 18th century were no longer cast directly from the blast furnace as were those delivered to the Spaniards two centuries earlier—they were cast from the reverberatory furnace. This furnace oxidized the silicon and the carbon of the blast furnace iron which might produce porous castings of mediocre mechanical properties in pieces as massive as the cannon; moreover, it permitted casting larger pieces than were possible with the blast furnace, and re-melting of grape shot and foundry scrap. Coal could be used as fuel.

It is evident that the castings current in the 16th century, which had a strong tendency to become white,

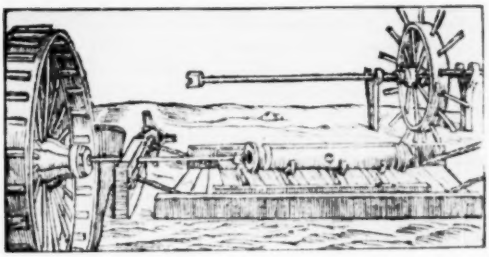
Above—Typical 17th century iron foundry. Cores used for bell castings are shown in the background.

Right—Collection of 18th century cast iron cooking utensils. As early as the 16th century the Vennes foundry was producing these as thin as 1/12-in. with only 0.40 per cent silicon in the iron.



Left—Charcoal blast furnace of 18th century with blast provided by water-driven bellows. Mill pond was located at right of foundry.

Below—Machine used in 16th century for boring cannon. Illustration is from Biringuccio's Traité de Pyrotechnic.



were not at all suitable for the manufacture of thin cooking utensils, constantly exposed to sudden variations of temperature and to the repeated shocks which they received from the housewives. However, in the 16th century the Vennes foundry had solved this difficult problem, for it was producing cast iron pots and casseroles of 1/6, 1/8, 1/10, and even 1/12-in. thicknesses, with silicon contents of only 0.60, 0.50, and even 0.40 per cent.

Modern foundrymen will find it difficult to believe it possible to obtain such results, but laboratory examination of numerous ancient pots and tests in the foundry have proved it. In fact, long research has shown that the ancient foundrymen of Vennes succeeded in making very thin gray iron castings in spite of low silicon content because they utilized iron ore containing an energetic graphitizer, generally zinc. To cast kitchenware they employed iron ore from the lodes or from beds near zinc mines (calamine or blende); in both cases the iron ore contained zinc.

The light gray fracture of the old kitchenware castings is due to two components, one dark, the other light. Under the microscope the dark cells appear as a core of graphite with divergent lamellae in the mass of pearlite. The network between the cells is cementite accompanied by steadite when the casting is high in phosphorus. Therefore, before solidification of these ancient kitchenware castings, with a low silicon content and a tendency to whiten, the zinc acted as a graphitizer, favoring the formation of cores of graphite, and becoming volatile when the temperature of the casting was sufficiently high.

After the disappearance of the zinc the solidification proceeded with formation of networks of cementite or of steadite around cores of graphite. The high carbon content of these castings contributed to the formation of graphite rosettes, which prevented the formation of an entirely white and fragile casting. The networks of cementite or of steadite which surrounded these rosettes prevented them from giving a bad taste to the foods cooked in the pots. As a result of these discoveries, patents concerning the graphitization of the castings have been registered.

Iron ores containing zinc were quite rare and became more and more so. To procure it, the Vennes

Water pipe cast in 1822 shows good surface finish.

foundry for two centuries conducted a merciless fight against the foreign foundrymen who wanted to boycott it. The Vennes foundry went so far as to buy foreign foundries in order to put them out of work and utilize their kitchenware ore.

Products of the Liége foundry were not confined to cannon and cooking utensils. For example, at the time of the American War of Independence, it also manufactured parts for industry—rolling mill cylinders, anvils, nozzles, etc., which were at times cast in a chill-mold; parts for buildings—columns, balcony grilles and railings; water pipes; and parts for the heating of houses—chimney plates, andirons, and stoves.

At the beginning of the 19th century Vennes foundry began to be short of charcoal and coke blast furnaces were installed, to which hot air was adapted some years later. These two innovations caused the silicon content of the castings to go suddenly from 1.5 to 2 or 3 per cent and more. The new iron, supersaturated with graphite, was found to be unsuitable for a certain number of former uses, even after being remelted in the cupola. It was necessary to accomodate the practice to this new metal of a quality inferior to the old one, but adequate for new manufactures.

The quality of castings made almost no progress until shortly before the war of 1914, as it was only at that period that metallurgists began to study castings scientifically. As soon as the first world war was over, the Vennes foundry, which had been almost entirely destroyed, reorganized its laboratory under the direction of a professor of metallurgy of the University of Liége. They studied and established a whole range of special castings which were produced in different melting apparatuses—cupolas, air furnaces, pulverized-coal rotary furnaces, and electric furnaces.

In the same period the foundry was the first on the continent to adopt the de Lavaud process for casting iron pipe. Unfortunately, production which had exceeded 4,000 tons per month fell to 35 tons per month during the second world war, particularly during the battle of Bastogne. The plant then was producing only the parts necessary for repairs to the water and gas mains destroyed by the war.

As soon as the war ended in Belgium, the Vennes plant once more was rebuilt and adopted new processes of manufacture. As it was the first continental foundry after the war of 1914 to accomplish the manufacture of pipe by centrifugal casting, it was the first, after the second world war, to utilize the metallurgical blast cupola in its foundries.

The metallurgical blast cupola, new melting apparatus intermediate between the cupola and the blast furnace, permits not only simple melting operations, but also production of metal of a variety of desired analyses depending on the slag which the molten iron has traversed.

A.F.S. RESEARCH PROJECTS

Research projects of A.F.S. are conducted under definitive contracts with various institutions which have the necessary personnel and mechanical facilities. Reports on each project are required at regular intervals.

"Research" is just that—*search* and *re-search*. It is not like production where reasonably well-known materials, proved methods and engineered designs are employed to turn out salable products. Research commences with an idea and many unknown factors, all of which must be examined by trial and error before the actual idea itself can even be approached.

Results of A.F.S.-sponsored research, when in publishable form, are available to everyone. Quarterly progress reports and visits and consultation with the researchers keep the committees directing the work informed on project developments. Annual reports on the various researches under Society sponsorship will become a regular feature of the Annual A.F.S. Convention.

Title of Project	Group Directing Work	Institution
Hydraulics of Light Metal Flow into Molds	Research Committee, Aluminum and Magnesium Division	Battelle Memorial Institute
Fracture Test as an Index of Melt Quality	Research Committee, Brass and Bronze Division	University of Michigan
Centrifugal Casting of Light Metal Alloys	Centrifugal Casting Committee, Aluminum and Magnesium Division	Canadian Bureau of Mines
Influence of Heredity on Coke Behavior in the Cupola	Cupola Research Committee	U. S. and Canadian Bureaus of Mines, Ford Motor Co., and Eaton Mfg. Co.
Fundamentals of Heat Flow During Casting Solidification	Heat Transfer Committee	Columbia University
Effect of Melting Conditions on Behavior of Malleable	Research Committee, Malleable Division	
High Temperature Properties of Molding Sands	Research Committee, Sand Division	Cornell University
Relation of Cores to Hot Tearing	Research Committee, Steel Division	Armour Research Foundation
Risering of Gray Iron	Research Committee, Gray Iron Division	Massachusetts Institute of Technology

Abstracts of Technical Literature

Abstracts below have been prepared by Research Information Service of The John Crerar Library from current American and foreign literature. For literature searches and translations of technical, industrial, and scientific literature, and photostats and microfilm, write to: Research Information Service, The John Crerar Library, 86 East Randolph Street, Chicago 1, Ill.

Melting Aluminum Alloys

75—Cast Iron Crucibles. Jean Dupont, "On the Use of Metal Crucibles for Melting of Aluminum Alloys," *Fonderie*, no. 52, Apr. 1950, pp. 2017-2023 (in French).

Metal crucibles, whose use in war-time France was motivated by raw material shortages, may still present some advantages economically. The author gives information on the cast-iron crucibles destined for melting of aluminum alloys. Their useful properties and defects, the composition of the material employed for their fabrication, their dimensions and shapes are surveyed, and indications are given on the kinds of aluminum alloys for which the use of cast-iron crucibles should be avoided.

Converter Blasts

76—Influence of Blast Gases. Hans Kosmider and Paul E. Hardt, "Oxygen and Water-Vapor Blast Experiments in a Small Converter," *Stahl und Eisen*, vol. 70, Apr. 13, 1950, pp. 303-321 (in German).

Using a two-ton Thomas-iron converter, experiments were made on blasts containing various quantities of oxygen and water vapor. The influence of those gases on the nitrogen movement and the heat exchange was studied, as was the effect of the various slags (Ca, Na, and Ca-Na) on the removal of phosphorus and the oxygen content of the steel. Observations were made on the behavior of the dolomite when oxygen, water vapor, and oxygen-enriched blasts were used. Experiments with blasts containing 92 per cent oxygen and argon served as tests of the oxide-film theory.

Brass and Bronze Porosity

77—Degassing Processes. P. O. Bjorkman, S. Brennert, A. Hentz and A. Wallgren, "Influence of Hydrogen and Water Vapor on Tin Bronze and Red Brass," *Gjuteriet 40*, 61-67 (1950) May (in Swedish).

Porosity in red brass and tin bronze is caused by gases (mainly H and O from water vapor) absorbed during melting. The presence of reducing elements, such as Sn, Zn and P, increases the proportion H:O. Degassing of a bronze melt requires an oxidation followed by deoxidation. The author experimented with various oxidizing agents. Thus, good results were obtained with manganese ores, while Cu_2O proved a mediocre oxidizer; lithium copper has good properties as an all-round scavenger, but is too expensive.

Making Large Gears

78—Methods for Cast Iron, Bronze, Steel. W. H. Hopkins, J. H. West and H. G. Goyns, "The Casting of Gear Wheels," *The Engineer and Foundryman*, vol. 14, Mar. 1950, pp. 39-47, 67.

A discussion is given on the casting of large gears in cast iron, bronze, or steel. Each material is treated separately—method and equipment, molding operations, core boxes and core making, coring up and closing the mold, and casting. The gear wheel considered is 8 ft. 2 in. in diameter and has machine-cut teeth. The rough iron casting weighs approx. $6\frac{1}{2}$ tons.

Nodular Iron Crystallization

79—Magnesium Effects Nucleation. A. L. De Sy, "The Core of Graphite Spherules in Nodular Cast Iron," *Metal Progress*, vol. 57, June 1950, pp. 774-775.

The author presents three photomicrographs at magnifications of 500, 2000, and 7000 diameters, respectively, the latter two being electron micrographs, showing a light colored core in the center of the spherulites. From the results presented it is the belief of the author that crystallization of nodular iron is nucleated by a magnesium compound, and that the graphite spherulite is produced from a complex magnesium-silicon-carbide.

Cast Iron Machinability

80—Tool Life Increased. E. A. Loria and R. L. Keller, "A Machinability Test for Treated Cast Iron," *Iron Age*, vol. 165, June 1, 1950, pp. 73-76.

Thin-section gray iron castings are susceptible to surface hardening effects that lower machinability. Use of silicon carbide cupola addition agents lessens chilling tendency and improves machinability. Tests show increases in tool life from 50 to 100 per cent. Five figures and four references are included.

Granular Material Deviation Formula

81—Apply Equation to Sampling Data. David Buslik, "Mixing and Sampling with Special Reference to Multi-Sized Granular Material," *ASTM Bulletin*, vol. 165, April 1950, pp. 66-73.

A formula is derived for the standard deviation of the per cent of a given size in random samples from a granular material with a known size distribution. It is shown to be applicable to the study of the mixing of multi-sized material. A discussion of the mixing operation from the statistical point of view is presented to clarify the application of this equation in such studies. The arrangement of particles in a well-mixed aggregate of multi-sized material is discussed. It is shown that with such mixing under certain conditions the mode of packing of the pieces might be determined by applying the proposed equation to sampling date.

Diversified British Foundry

82—Many Casting Types Produced. "A Triple-Purpose Foundry—Mechanized, Semi-Mechanized and Jobbing," *Iron and Steel*, vol. 23, June 1950, pp. 289-294.

A foundry is described in which three distinct types of production are handled: (1) mass production in mechanized plant where large continuous runs of uncored and some cored items, such as flywheels, brake drums, manifolds, gearboxes, etc., are made; (2) medium repetition on molding machines and roller conveyors where parts like car cylinder blocks are processed; (3) jobbing work by floor molding for small production runs such as large diesel engine beds. A diagrammatic plan of the mechanized foundry and several photographs are included.

Steel Heats Desulphurized

83—Al-Mg Alloy Additions. S. L. Gertsman, "Magnesium Alloys Aid Desulphurization," *Iron Age*, vol. 165, June 15, 1950, pp. 104-107.

Experiments on desulphurization of steel using a 50 per cent aluminum, 50 per cent magnesium alloy resulted in a steel of 0.010-0.015 per cent lower sulphur content. The heats were prepared in an induction furnace. Two tables showing the results of magnesium treatment and the effect on mechanical properties are included in the article, along with four photomicrographs.

Cupola Relining

84—Reduce Patching Cost. Victor E. Hillman, "New Gun Relines Cupola in One Hour," *Iron Age*, vol. 165, May 4, 1950, pp. 94-95.

Relining costs have been more than halved by the use of a new high velocity gun employing a wet refractory mix. Thicknesses up to 10 in. are applied. Some advantages in using the gun are: patching time is reduced; quality of patch is uniform; no bricks are needed.

Molding Process

85—Improve Accuracy and Finish. Ove Holl, "Cronite Moulding," *Gjuteriet*, vol. 10, June 1950, pp. 90-91 (in Swedish).

To improve the accuracy, decrease the work needed in ramming and reduce the amount of molding material required in green sand molding a rapidly drying molding material of high dry strength has to be developed. The "C-process" is an attempt to approach this problem. By utilizing a synthetic resin bonded sand and preheated pattern plates and core boxes (200-300 C) a thin shell of sand forming a mold cavity is obtained. This shell of sand is backed up by steel shot during pouring and solidification of the casting. The process is not versatile but it has certain advantages for smaller castings. Dimensional accuracy and surface finish are superior to those obtained in ordinary green or dry sand molds.

Desulphurizing Iron

86—Treatment in Ladle. E. P. Best, "Special Ladle Technique Eliminates 90 Per Cent of Sulphur in Iron," *Steel*, vol. 126, June 19, 1950, pp. 108-110.

A process which eliminates 90 per cent or more of the sulphur in iron is described. This is accomplished by using a special ladle treatment with sodium hydroxide just before bessemerizing. The steps involved in the process are: (1) in the initial ladle the solid desulphurizer is melted and some of the sulphur removed; (2) in the second ladle an additional quantity of the remaining sulphur is removed and the slag mechanically skimmed; (3) the third ladle merely provides a receptacle for transporting the fully desulphurized iron to the converter for blowing. Two figures and three tables are included in the article.

Effect of Section Size

87—Apply Structure Diagrams. M. Stap, "The Use of the Weichelt Diagram in the Manufacture of Pearlitic Cast Iron," *Metallen*, vol. 4, June 1950, pp. 201-212 (in Dutch).

Several attempts have been made to express by a formula or a diagram the combined influence of C and Si contents on the mechanical properties or the structure of cast irons. The so-called "saturation-degree" formulas (Hanemann and Schrader, et al.) and Maurer's diagram are mentioned; then Weichelt's structure diagram, the most satisfactory solution of the problem so far given, is described in detail. In this diagram the abscissas are per cent Si, and the ordinates per cent C; several curves delimitate regions of typical structures, viz. cementitic, pearlitic, ferritic and several intermediates. The pearlitic variety of cast iron being considered the most important industrially, the influence of the thickness of the casting walls on the shape of the diagram in its pearlitic region is studied, as well as the effect of the presence of Cr.

FEF Objectives

88—Foundry Engineering. George K. Dreher, "The Foundry Industry Molds Its Future," *Iron Age*, vol. 165, May 4, 1950, pp. 83-88.

The foundry industry established the Foundry Educational Foundation to carry out certain objectives. These are: (1) to improve education in the field of foundry engineering; (2) to encourage and assist foundry engineering students; and (3) to develop adequate instruction to carry out these purposes.

Cupola Practice

89—Using Oxygen in Blast. E. S. Clark, "Added O_2 Improves Cupola Output," *Iron Age*, vol. 165, May 4, 1950, pp. 96-100.

Improved performance was obtained by enriching the cupola blast with oxygen. This resulted in the use of less coke, the melting rate was increased, higher temperatures were possible at the spout, and bridging was decreased.

Letters to the Editor

All letters of broad interest which do not violate A.F.S. policy or good taste are publishable. Write to Editor, American Foundryman, 616 S. Michigan Ave., Chicago 5, Ill. Letters must be signed but will be published anonymously on request.

Experiments With Perlite

Since writing the article *"Mineral Perlite—Foundry Use"* which you ran in the July issue of American Foundryman, I've done some additional work with this unusual material to show how it insulates risers to keep them fluid longer.

We molded two bronze cylinder castings for a 10-in. high lift angle valve exactly alike, except that the riser over the heaviest section formed by the juncture of the cylinder bore, gland bosses, and strengthening brackets was insulated in one mold and not insulated in the other.

The insulation used consisted of a baked collar of ground sil-o-cel and granular perlite bonded with air-setting fireclay cement. The central riser was $3\frac{5}{8}$ in. in diameter at the top, $3\frac{7}{8}$ in. at the bottom and $5\frac{1}{2}$ in. high, and on each casting had a thermocouple inserted as shown in the illustration.

Both castings were poured from the same ladle of valve bronze "M" at 2150 F. The insulated riser was given a cover of powdered perlite. Both molds were poured to the same height and after solidification, the top of the insulated riser was $\frac{1}{4}$ in. lower than the corresponding uninsulated riser on the other casting. Readings from the thermocouples show that metal for the uninsulated riser casting poured first was 10 degrees hotter than the metal for the casting with the insulated riser.

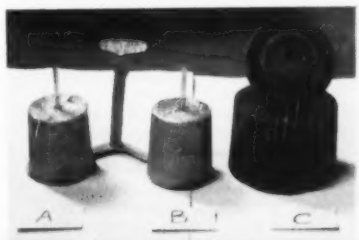
Both risers reached a peak of 1900 F. In two minutes the uninsulated riser solidified at 1830 F but the insulated riser did not reach 1830 F until six minutes after pouring. The insulated riser thus had a full four minutes longer of feeding time.

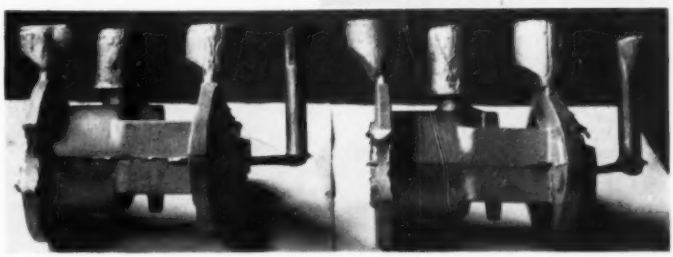
In another experiment we molded two billets $5\frac{1}{4}$ in. in diameter and 6 in. high together, bottom gating them from a common sprue. One billet was insulated all around, the other not. The billets were poured at 2140 F using Navy Spec. 46B8b valve bronze. Thermocouples were inserted in the tops of the billet cavities.

While pouring, the insulated billet reached a peak of 1980 F. Peak for the uninsulated billet was 1940 F. Over a period of two minutes the uninsulated billet dropped to 1850 F while the insulated billet required four minutes to reach the same temperature. The uninsulated billet held at 1850 F for three minutes, the insulated for five minutes, giving it a four minute advantage in solidification time up to this point. At 1830 F, the approximate point of solidification, the insulated billet had another advantage of six minutes.

E. D. Boyle, *Master Molder*
Puget Sound Naval Shipyard
Bremerton, Wash.

Right—Billets poured of valve bronze. A was uninsulated. B was surrounded with insulating material, including perlite, shown at C. Tubes frozen in tops of billets contained thermocouples which showed that the insulation kept the metal in B molten 10 minutes longer than in A. Below—Central riser of valve casting at left was surrounded with an insulating collar, central riser of casting at right was in sand. According to thermocouples (note wires) the riser on the left-hand casting was effective four minutes longer than the central riser in the photograph on the right.





A.F.S. Foundry Glossary - - -
DEFINES USEFUL FOUNDRY TERMS

IN PRE-PUBLICATION FORM, the final part of an extensive foundry terms glossary to be published by the American Foundrymen's Society is presented in this issue of AMERICAN FOUNDRYMAN. Preceding two issues contained remainder of the glossary. Object of preliminary publication of this work is to secure comments and criticism of readers to the end that the final booklet will be as complete and useful to the foundry industry as possible. Cooperation is solicited and suggestions for changes, additions, and deletions should be sent to Jos. E. Foster, Technical Assistant, American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill.

Final version of the glossary will combine comments of AMERICAN FOUNDRYMAN readers with those of a newly organized Committee on Foundry Terminology made up of members of each A.F.S. Division. Result will be a comprehensive explanation of terms used in the foundry industry.

PART III

(Continued from August issue)

heat—A stated tonnage of metal obtained from a period of continuous melting in a cupola or furnace; or the melting period required to handle this tonnage.

holding furnace—A small furnace for maintaining molten metal, from a larger melting furnace, at the right casting temperature.

homogenization—A prolonged heating to correct, by diffusion, the microsegregation of constituents.

horn gate—A semicircular gate to convey iron over or under certain parts of a casting so that it will enter the mold at or near the center; also as a skim gate.

hot deformation (sand)—The change of form of a sand specimen which accompanies the determination of hot strength.

hot permeability (sand)—The property of a molded sand mixture to pass through it gases at any temperature above room temperature.

hot shortness—Brittleness in hot metal.

hot sprung—Removing castings from gates before the metal has completely solidified. Hot sprung is necessary on light-section or intricate castings which might be cracked if cold sprued.

hot strength (sand)—Tenacity (compressive, shear, tensile or transverse) of a sand mixture determined at any temperature above room temperature.

hot tear—Surface discontinuity or fracture caused by either external or internal stresses or a combination of both acting on a casting during solidification after pouring and subsequent contraction at temperatures near the solidus.

hub—A projection, round or otherwise, usually the center of some rotary movement.

humectant—Any material added to foundry sand to retain moisture.

hypereutectoid steel—A steel containing more than the eutectoid percentage of carbon. See EUTECTOID STEEL.

hypoeutectoid steel—A steel containing less than the eutectoid percentage of carbon. See EUTECTOID STEEL.

I

impact test—A test to determine the energy absorbed in fracturing a test bar at high velocity; may be in tension or in bending, or it may properly be a notch test if a notch is present, creating multiaxial stresses.

impoverishment—Loss of any constituent from an alloy or from localized areas of an alloy by oxidation, liquation, volatilization or changes in the solid state. The term "depletion" is also used, particularly in referring to the lowering of the concentration of solute in a solid solution, around particles precipitated from solid solution.

inclusions—Particles of impurities (usually oxides, sulphides, silicates and such) that are held mechanically, or are formed during solidification or by subsequent reaction within the solid metal.

induction hardening—Process of hardening a ferrous alloy by heating it above the transformation range by means of electrical induction, and then cooling as required.

induction heating—Process of heating by electrical induction.

inhibitor—(1) A material such as fluoride, boric acid or sulphur, used to prevent burning of molten magnesium alloys or for restraining an undesirable chemical reaction. (2) An agent added to pickling or other solutions to minimize corrosion.

inoculant—Materials which when added to molten cast iron modify the structure, and thereby change the physical and mechanical properties to a degree not explained on the basis of the change in composition resulting from their use.

inoculation—Addition to molten metal of substances designed to form nuclei for crystallization.

inserts—In die casting, parts formed from a second material, usually a metal, which are placed in the mold and appear as integral structural parts of the final casting.

internal friction—Ability of a metal to transform vibratory energy into heat; generally refers to low stress levels of vibration; *damping* has a broader connotation since it may refer to stresses approaching or exceeding the yield strength.

internal stresses—A system of balanced forces existing within a part which is not subjected to a working load.

inverse chill—Also known as reverse chill, internal chill and inverted chill, is the condition in a casting section where the interior is mottled or white while the outer sections are gray iron.

inverse segregation—A concentration of certain alloy constituents that have lower melting points, in the region corresponding to that first solidifying; caused by interdendritic flow of enriched liquid through channels where the pressure drops with contraction of dentrites. The internal evolution of hydrogen may also give a positive pressure, aiding this flow and causing a liquidated surface or tin sweat.

investment compound—A refractory used for molds formed around wax patterns.

iron, hard or white—The hard iron of suitable composition in which the castings, later to be malleablized, are originally cast. In it all carbon is in the combined form, hence its white fracture and name.

iron, malleable—A mixture of iron and carbon, including smaller amounts of silicon, manganese, phosphorus, and sulphur, which after being cast is converted structurally by heat-treatment into a matrix of ferrite containing nodules of temper carbon.

Izod test—A pendulum-type impact test, in which the specimen is supported at one end as a cantilever beam and the energy required to break off the free end is used as a measure of impact strength. See CHARPY TEST.

J

jacket—A wooden or metal form or box which is slipped onto a mold to support the four sides of the mold during pouring.

jacket, mold—A wooden or metal form which is slipped over a mold made in a snap or slip flask, to support the four sides of the mold during pouring. Jackets are shifted, with the mold weights, from one row of molds to another during pouring.

jar ramming, jolt ramming—The packing of the sand in the mold by raising and dropping upon a table of the sand, pattern and flask, the sand itself being the ramming medium. Jolt squeezers, jarring machines, and jolt rammers are molding machines using the principle of jar ramming.

jig—Any device so arranged that it will expedite a hand or machine operation.

jobbing foundry—A foundry engaged in the manufacture of numerous types of castings in small quantities. See PRODUCTION FOUNDRY.

K

keyhole specimen—A type of notched impact test specimen in which a hole and slot notch, shaped like a keyhole, gives multiaxial stresses.

killed steel—Steel deoxidized with a strong deoxidizing agent such as silicon or aluminum to reduce the oxygen content to a minimum so that no reaction occurs between carbon and oxygen during solidification.

kiln-dried—Lumber artificially dried by being placed in a specially designed enclosure called a kiln.

kish—Free graphite which has separated from molten iron.

knockout—Operation of removing sand cores from castings.

L

ladles—Metal receptacles lined with refractories and used for transporting and pouring molten metal.

lagging—The fastening of narrow lags or strips about batten foundations so shaped as to follow a line parallel to the required contour of the pattern.

laminated construction—Building up in a series of courses a pattern member of strips or segments with the alternating end joints occurring midway between those of the preceding course.

launder—A channel for conducting molten metal.

layout board—A board upon which a pattern layout is made.

ledeburite—Cementite-austenite eutectic structure.

life (of sand)—See DURABILITY.

light metals—Metals and alloys that have a low specific gravity, such as beryllium, magnesium and aluminum.

liquid contraction—Shrinkage occurring in metal in the liquid state as it cools.

liquidus—A line on a binary phase diagram or a surface on a ternary phase diagram, representing the temperatures at which freezing begins during cooling or melting ends during heating under equilibrium conditions.

loam—A mixture of sand, silt and clay particles in such proportions as to exhibit sandy and clayey particles in about equal proportions. It is roughly 50 per cent sand, and 50 per cent silt and clay.

loam molds—Molds built up of bricks, plates, and other sections covered with loam to give the form of the castings desired.

loose flange—Flange that may be drawn independently of the body of a pattern; often used in combination with a covering or sash core.

loose piece—Part of a pattern so attached that it remains in the mold and is taken out after the body of the pattern is drawn.

lost wax process—A precision casting process in which a wax pattern is used. The wax pattern is invested in a plaster slurry; then after the mold is dry, the wax is melted and poured out of the mold cavity.

low heat-duty clay—A refractory clay which fuses between cone 19 (1520 C, 2768 F) and cone 25 (1590 C, 2894 F).

lug—An earlike projection frequently split as the clamping lug on the tail stock or tool-rest slide of a lathe.

lute—(1) A mixture of fireclay used to seal cracks between crucible and cover or between container and cover when heat is to be applied. (2) To seal with clay or other plastic material.

M

machinability—The property of permitting tooling or finishing by machinery.

machine-cast pig—See CHILL-CAST PIG.

machine finish—Operation of turning or cutting from the surface of metal an amount of stock in order to produce a finished surface.

macrograph—A photographic reproduction of any object that has not been magnified more than ten times.

macroscopic—Visible either with the naked eye or under low magnification (as great as about ten diameters).

macrostructure—Structure of metals as revealed by macroscopic examination.

malleable cast iron—The product obtained by heat treatment of white cast iron which converts substantially all of the combined carbon into nodules of graphite.

malleability—The property of being permanently deformed by compression without rupture.

malleablizing—Process of annealing white cast iron in such a way that the combined carbon is wholly or partly transformed to graphitic or free carbon or, in some instances, part of the carbon is removed completely. See TEMPER CARBON.

marking a core—Shaping the core and its seat so that the core cannot be misplaced.

martempering—Process of quenching an austenitized ferrous alloy in a medium at a temperature in the upper portion of the temperature range of martensite formation, or slightly above that range, and holding in the medium until the temperature throughout the alloy is substantially uniform. The alloy is then allowed to cool in air through the temperature range of martensite formation.

martensite—An unstable constituent in quenched steel, formed without diffusion and only during cooling below a certain temperature known as the M (or Ar″) temperature. The structure is characterized by its acicular appearance on the surface of a polished and etched specimen. Martensite is the hardest of the transformation products of austenite. Tetragonality of the crystal structure is observed when the carbon content is greater than about 0.5 per cent.

mass hardness—A condition in which the entire casting is too hard and unmachinable.

master pattern—A pattern embodying a special contraction allowance in its construction, used for making castings that are to be employed as patterns in production work.

matched parting—Forming of a projection upon the parting surface of the cope half of a pattern and a corresponding depression in the surface of the drag.

match plate—A plate of metal or other materials, on which patterns, split along the parting line, are mounted back to back with the gating system to form an integral piece.

mechanical properties—The properties of a metal determining its behavior under stress.

medium pattern—A pattern used occasionally, which may therefore be of a cheaper nature than a standard pattern.

melting loss—Loss of metal in the charge during the operation of melting.

melting rate—The tonnage of metal melted per hour.

melting ratio—The proportion of the weight of metal to the weight of fuel in cupola melting.

melting zone—The portion of the cupola above the tuyeres in which the metal melts.

metal patternmaker—A highly skilled craftsmen engaged in production of foundry patterns from metals, such as, aluminum, brass, etc.

metal penetration—A casting surface defect which appears as if the metal has filled the voids between the sand grains without displacing them.

metallography—The science concerning the constitution and structure of metals and alloys as revealed by the microscope.

microporosity—Extremely fine porosity caused in castings by shrinkage or gas evolution and apparent on radiographic films as mottling.

microradiography—The process of passing x-rays through a thin section of an alloy in contact with photographic emulsion, and then magnifying the radiograph 50 to 100 times to observe the distribution of alloying constituents and voids.

microshrinkage—Very finely divided porosity resolved only by use of the microscope; may be visible on radiographic films as mottling.

microstructure—The structure of polished and etched metal and alloy specimens as revealed by the microscope.

mischmetal—An alloy of rare earth metals containing about 50 per cent cerium with 50 per cent lanthanum, neodymium and similar elements.

misrun—Cast metal that was poured too cold so that it solidified before filling the mold completely.

modification—Treatment of aluminum silicon alloys in the molten state with a small percentage of an alkaline metal or salt such as sodium fluoride to develop maximum mechancial properties in the metal.

modulus of elasticity—The ratio of stress to the corresponding strain, within the limit of elasticity of a material.

moisture—Water which can be driven off by heating at 221 to 230 F (105 to 110 C).

mold—The form, usually made of sand, which contains the cavity into which molten metal is poured.

mold board—Board upon which the pattern is placed to make the mold.

(Continued on Next Page)

GLOSSARY

(Continued from Preceding Page)

mold cavity – Impression left in the sand by a pattern.

mold clamps–Devices used to hold or lock cope and drag together.

mold shift–A casting defect which results when a casting does not match at parting lines.

mold wash–Usually an aqueous emulsion containing various compounds, such as graphite, silica flour and the like, used to coat the face of the cavity in the casting mold. See FACING.

mold weights – Weights placed on top of molds to offset internal or ferrostatic pressure during pouring.

molder's rule–A rule used in making patterns for casting, on which the graduations are expanded to account for thermal and solidification contraction of the metal being cast. See PATTERNMAKER'S SHRINKAGE.

molding, bench–Making sand molds from loose or production patterns at a bench not equipped with air or hydraulic action.

molding, floor – Making sand molds from loose or production patterns of such size that they cannot be satisfactorily handled on a bench or molding machine, the equipment being located on the floor during the entire operation of making the mold.

molding gravel – The coarser and more permeable grades of molding sand and generally used in producing castings of exceptional size and weight. See CHAMOTTE.

molding, machine – May refer to squeezer or jolt squeezer machines on which one operator makes the entire mold, or to similar or larger machines including jolt-squeeze-strippers, and jolt and jolt-rollover pattern draw machines on which cope and drag halves of molds are made.

molding material – Substance that is suitable for making molds into which molten metal can be cast.

molding sand – Sand containing sufficient refractory clay substance to bond strongly without destroying the permeability to air and gases when rammed to the degree required.

mottled cast iron–Cast iron which consists of a mixture of variable proportions of gray cast iron and white cast iron; such a material has a mottled fracture.

muller – A type of foundry sand mixing machine.

multiple mold–A composite mold made up of stacked sections, each of which produces a complete gate of castings and is poured from a central down-gate.

N

natural aging – Spontaneous aging of a supersaturated solid solution at room temperature.

naturally bonded molding sand – A sand containing sufficient bonding material as mined for molding purposes.

network structure – A structure in which the grains or crystals of one constituent are partly or entirely enveloped in another constituent; an etched section through the crystals resembles a network.

neutral refractory – A refractory material which is neither definitely acid nor definitely basic. The term is merely relative in most cases, since at high temperature such a material will usually react chemically with a strong base, functioning as a weak acid; or with a strong acid, functioning as a weak base. Chrome refractories are the most nearly neutral of all commonly used refractory materials.

nitriding – A process of case hardening in which a ferrous alloy, usually of special composition, is heated in an atmosphere of ammonia or in contact with nitrogenous material to produce surface hardening by absorption of nitrogen, without quenching.

nodular graphite–Graphite or carbon in nodular form, characteristic in malleable iron and in nodular iron.

nodular iron – Cast iron which has all or part of its graphitic carbon content in the nodular or spherulitic form as cast.

nonferrous–Term refers to alloys in which the predominant metal or solvent is not iron.

normalizing–A process in which a ferrous alloy is heated to a suitable temperature above the transformation range and is subsequently cooled in still air at room temperature.

normal segregation – Concentration of alloying constituents that have low melting points, in those portions of a casting that solidify last. Compare with *inverse segregation*.

notch bar–Small size ingot with notches to facilitate breakage.

nowel – A colloquial term for drag mold; the term *drag* is preferred.

nucleus–The first structurally determinate particle of a new phase or structure that may be about to form. Applicable in particular to solidification, recrystallization and transformations in the solid state.

nugget – A small mass of a metal such as gold or silver, as found in nature.

O

off-grade metal–Metal whose composition does not correspond to the designated specification.

one-piece pattern–Solid pattern, not necessarily made from one piece of wood.

open grain structure–A defect wherein a casting, when machined, appears too coarse grained for the application.

open hearth furnace–A furnace for melting metal, in which the bath is heated by the convection of hot gases over the surface of the metal and by radiation from the roof.

operating stress – The stress to which a structural unit is subjected during service.

optical pyrometer–A temperature measuring device through which the observer sights the heated object and compares its incandescence with that of an electrically heated filament whose brightness can be regulated.

optimum moisture–That moisture content which results in the maximum development of any property of a sand mixture.

overaging–Aging under conditions of time and temperature greater than those required to obtain maximum strength.

overhang – The extension of the end surface of the cope half of a core print beyond that of the drag in order to provide clearance for the closing of the mold.

overheated – A term applied when, after exposure to an excessively high temperature, a metal develops an undesirably coarse grain structure but is not permanently damaged. Unlike *burnt* structure, the structure produced by overheating can be corrected by suitable heat treatment, by mechanical work, or by a combination of the two.

oxidation – Any reaction whereby an element reacts with oxygen.

P

packing or packing material–Sand, gravel, mill scale, or other similar material used to support castings packed in annealing pots, to prevent possible warpage.

pad – Shallow projection on a casting distinguished from a boss or lug by shape and size.

parted pattern – Pattern made in two or more parts.

parting – The zone of separation between the cope and drag portions of mold or flask in sand casting.

parting compound – A material dusted or sprayed on patterns to prevent adherence of sand.

parting line–A line on a pattern or casting corresponding to the separation between the cope and drag portions of a sand mold.

parting sand–Finely ground sand for dusting on surfaces that are to be separated in making a sand mold.

pattern – A form of wood, metal or other materials, around which sand is packed to make a mold for casting metals.

pattern board – Board reinforced with cleats, having a true surface upon which pattern is laid for ramming of drag.

pattern checking–Verifying dimensions of a pattern with those of the drawing.

pattern layout – Full-sized drawing of a pattern showing its arrangement and structural features.

pattern coating–Coating material applied to wood patterns to protect them against moisture and abrasion of molding sand.

pattern letters and figures – Identifying symbols affixed to a pattern as a means of keeping a record of the pattern and for the identification of the casting.

patternmaking – Highly skilled craft of modeling in wood, metal, or other materials objects to be cast in metal.

pattern members – Component parts of a pattern.

pattern plates–Straight flat metal or other plates on which patterns are mounted.

patternmaker's shrinkage – Shrinkage allowance made on all patterns to compensate for the change in dimensions as the solidified casting cools in the mold from freezing temperature of the metal to room temperature. Pattern is made larger by the amount of shrinkage characteristic of the particular metal in the casting and the amount of hindered contraction to be encountered. Rules or scales are available for use. See MOLDER'S RULE.

(Continued on Page 82)

WHO'S WHO

F. Schumacher

Franz Schumacher, inventor of the Schumacher Process described in *"Insertion Process Cuts Cost of Matchplate Manufacture,"* Page 30, is a native of Germany, where he received a master's degree in pattern-making . . . He has been chief pattern-maker for Cooper Alloy Foundry Co., Hillside, N. J., since 1945 . . . Mr. Schumacher has contributed several articles to the technical press on plastic matchplates and has spoken before A.F.S. chapters in the United States and Canada on modern techniques in patternmaking.

Robert Doat

Robert Doat, author of *"400-Year-Old Belgian Foundry,"* Page 57, is engineering assistant to the management of Compagnie Generale des Conduites d'Eau at Liege, Belgium, whose 400-year history he summarizes in the article . . . A graduate in metallurgical engineering of the University of Liege, Belgium, Mr. Doat has since been Professor of metallurgy at the Institute Gramme in Liege in addition to his work at Compagnie Generale des Conduites d'Eau . . . He has been a frequent speaker at foundry conventions both in Belgium and abroad and attended the 1950 A.F.S. Foundry Congress & Show in Cleveland last May as representative of the Association Technique de Fonderie de Belgique (Belgian Foundry Association).

J. E. Rehder

J. E. Rehder, author of *"Desulphurizing Gray Iron with Magnesium,"* Page 43, needs little introduction to foundrymen in the United States and Canada . . . One of the most prolific writers on foundry practices and metallurgy, he has been a prominent speaker at many conventions of the American Foundrymen's Society . . . Holder of a B. E. (Met) from McGill University and a Dawson Fellowship, Mr. Rehder was chief metallurgist for several prominent Canadian foundries prior to accepting his present position as foundry engineer with the Canadian Bureau of Mines, Ottawa . . . He has been an active member of the A.F.S. Cupola Research, Controlled Atmospheres Annealing and College Research Projects Committees.

Robert Ronceray

Robert Ronceray, who authored the article, *"French FoundryCastsChain Centrifugally,"* on Page 41, heads one of France's most important foundries, Bonvillain et Ronceray, Choisy le Roi, Seine, France . . . Son of the late Dr. E. V. Ronceray, recipient of the A.F.S. John H. Whiting Gold Medal in 1926, Robert Ronceray grew up with the foundry industry, serving his apprenticeship in several French foundries and pattern shops . . . Graduating from the Paris Foundry School in 1926, he has since served in various foundry capacities with Citroen Motors, Paris, Packard Motors and Sanford-Riley Stoker Co. of Detroit, Nicholls and Shepherd of Battle Creek, Mich., Central Foundry Div., GMC, Saginaw, Mich., Massey Harris Co., Marquette, France and today is president and general manager of Bonvillain et Ronceray . . . Mr. Ronceray attended the 1950 A.F.S. Foundry Congress & Show in Cleveland last May.

H. W. Bennett

H. W. Bennett, author of *"Gates and Risers for High-Dross Non-Ferrous Alloys,"* Page 24, is nearing a half-century of service to the foundry industry . . . Apprentice supervisor for Dominion Engineering Works, Lachine, Que., he has for many years been one of Canada's most active workers in inducing young men to enter the foundry industry . . . After serving his apprenticeship with Robert Mitchell Co., Ltd., Montreal, Mr. Bennett became a molder with that firm and since 1908 has been brass foundry superintendent with several prominent Canadian foundries, prior to his present position as apprentice training supervisor.

Milton Sherman

Milton Sherman, *author of "Direct Colorimetric Determination of Copper and Iron in Tin and Lead Base Alloys,"* Page 54, is chief chemist for Silverstein & Pinsof, Inc., Chicago smelting firm . . . Holder of a B.S. in chemical engineering from the Illinois Institute of Technology, Mr. Sherman's previous position was with Pittsburgh Testing Laboratories, Chicago, as chemist and later chief chemist . . . He has written for the technical press and has spoken before meetings of various trade and technical groups, including those of the American Foundrymen's Society.

Vaughn D. Hildebrandt, author of *"Binary Copper-Beryllium Casting Alloy,"* Page 34, has divided his career between the Army, the foundry industry and teaching of metallurgy since attending Michigan State College, East Lansing, Mich., where he received his B.S. in chemical engineering with honors, held the Michigan State College Annual Fellowship, received his M.S. in metallurgical engineering in 1946 and his Ph.D. this year. Serving as a Captain in the Army from 1942 to 1944, he joined Ford Motor Co. as metallurgist in 1944, leaving there in 1945 to become graduate assistant at Michigan State College and later instructor in chemistry and metallurgical engineering . . . He is today assistant professor of metallurgical engineering at the University of Illinois, Urbana.

GIFS Publishes Employee Safety Booklet

First step in a broad safety program initiated by the Gray Iron Founders' Society is the publication of a pocket-size booklet, *"How You Can Work Safely,"* for distribution to gray iron foundry employees.

The booklet covers all general and departmental safety hazards existing in gray iron foundries and provides a means of insuring that each employee reads the booklet and has been instructed by his foreman in hazards applicable to his particular job.

Priced at $.20 per copy, plus moderate cover imprinting charge, booklets are available from Gray Iron Founders' Society, Inc., 210 National City–East 6th Bldg., Cleveland 14, Ohio.

New AFS MEMBERS

NEW COMPANY MEMBERS

Carboloy Co., Detroit—Eugene F. Wambold, Vice-Pres. in Charge of Mfg. (Detroit Chapter).

Cherry-Burrell Corp., Sheboygan, Wis.—Fred Ristow, Jr., Supt. (Wisconsin Chapter).

Crown Pipe & Foundry, Inc., Jackson, Ohio—M. V. Rhyan, Secy.-Treas. (Central-Ohio Chapter).

The Eastern Malleable Iron Co., Wilmington, Del.—Geo. E. Bean, Mg. Dir., (Philadelphia Chapter) —Conversion from Personal.

International Graphite & Electrode Corp., St. Mary's, Pa.—John W. Lohnes, Gen. Mgr. of Sales—Conversion from Personal.

Productive Equipment Corp., Chicago—Frank W. Porter, Chief Engr., (Chicago Chapter). Conversion from Personal.

Sonith Industries, Inc., Indianapolis—H. O. Bailey, Vice Pres. & Works Mgr. (Central Indiana Chapter).

Studebaker Corp., South Bend, Ind.—Emil Schmidt, Fdy. Supt. (Michiana Chapter).

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John J. Bowers, Maint. Supt., Central Foundry Co., Holt, Ala.
Harbert L. Brown, Machinist, Alabama Cast Iron Pipe Co., Birmingham, Ala.

CANTON DISTRICT CHAPTER

John L. Dickerson, Design Engr., The Pitcairn Co., Barberton, Ohio.
Wendell W. Snodgrass, Sand Lab., Massillon Steel Casting Co., Massillon, Ohio.

CENTRAL ILLINOIS CHAPTER

B. W. Branson Office Mgr., Peoria Malleable Castings Co., Peoria, Ill.
W. Frank Burke, Pay Master, Peoria Malleable Castings Co., Peoria, Ill.
William K. Butterfield, Appr., Caterpillar Tractor Co., Peoria, Ill.
Richard D. Saletzki, Appr., Caterpillar Tractor Co., Peoria, Ill.

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G. H. Nelson, Indiana Copper Corp., Marion, Ind.
Sonith Industries, Inc., Indianapolis—(H. O. Bailey, Vice Pres. & Works Mgr.).

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R. D. Rose, Sales Repr., Industrial Metal Abrasives Co., Jackson, Mich.
Robert D. Schelleng, Student, University of Michigan, Ann Arbor, Mich.

CENTRAL NEW YORK CHAPTER

Elmer Beavers, Gen. Supt., Frazer & Jones Co., Div. of Eastern Malleable Iron Co., Solvay, N. Y.

CENTRAL OHIO CHAPTER

John J. Breckur, Supv. of Castings & Patterns, Denison Engineering Co., Columbus, Ohio.
La Verne Conrad, Fmn., Ohio Malleable Iron Co., Columbus, Ohio.
Crown Pipe & Foundry, Inc., Jackson, Ohio (M. V. Rhyan, Secy.-Treas.)
Gerald W. Davis, Fmn., Ohio Malleable Iron Co., Columbus, Ohio.
Kelsie DeMent, Works Mgr., Crown Pipe & Foundry, Inc., Jackson, Ohio.
Harry E. Grabel, Asst. Fmn., Ohio Malleable Iron Co., Loudon, Ohio.
Gilmond W. Hart, Supv. of Patterns, Ohio Malleable Iron Co., Columbus, Ohio.
Joseph Knies, Fdy. Fmn., Ohio Malleable Iron Co., Columbus, Ohio.
Henry F. Morrison, Supt., International Derrick & Equip. Co., Delaware, Ohio.
Pat Susi, Fmn., Ohio Malleable Iron Co., Columbus, Ohio.
Victor Urbano, Fmn., Ohio Malleable Iron Co., Columbus, Ohio.
J. W. Wilson, Vice Pres., Portsmouth Clay Refractories Co., South Webster, Ohio.
Robert R. Wilson, Asst. Fmn., Ohio Malleable Iron Co., Columbus, Ohio.

CHICAGO CHAPTER

Sam Beluscheck, Chief Insp., Burnside Steel Foundry Co., Chicago.
Robert L. Geist, Productive Equipment Corp., Chicago.
Leo R. Kebort, Engr., Trainee, C. O. Bartlett & Snow Co., Chicago.
Robert S. Lewis, Supt., American Brake Shoe Co., Melrose Park, Ill.
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Milton Sherman, Chief Chemist, Silverstein & Pinsof, Inc., Chicago.
R. H. Stover, Great Lakes Carbon Corp., Chicago.
Dean Van Order, Indus. Engr., Burnside Steel Foundry Co., Chicago.
Thomas R. Whitacre, Dist. Sales Repr., Federal Foundry Supply Co., Elmwood Park, Ill.
Richard William Wilson, Assoc. Met., Armour Research Foundation, Chicago.

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Arlen S. Sjelby, Student, University of Cincinnati, Cincinnati.

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Carboloy Co., Detroit (Eugene F. Wambold, Vice-Pres. in Charge of Mfg.)
Robert W. Muhlitner, Exec. Vice Pres., Great Lakes Foundry Sand Co., Detroit.
Arthur C. Olfs, Jr., Factory Repr., Fanner Manufacturing Co., Detroit.

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Isaac Stuppel, Fdy. Sales, La Salle Builders Supply, Ltd., Montreal, Que., Canada.

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Ralph E. Cox, Application Engr., General Electric Co., Schenectady, N. Y.
Scott Mackay, Prof. of Met. Engrg., Rensselaer Polytecnic Institute, Troy, N. Y.

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Andrew Davlin, Sales Repr., Daniel Goff Co., Haledon, N. J.
Alfred N. Skinner, Salesman, Sacks-Barlow Foundries, Inc., Newark, N. J.

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Enrique Alquicira M., Fundiciones de Fierro y Acero S. A., Mexico, D. F., Mexico.
Rafael Levy, Student, Mexico, D. F., Mexico.
Nicolas Yris Rovirosa, Student, Chemical Met., University of Mexico, Mexico.

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Philip M. Semler, Fmn., Melting Dept., Auto Specialties Mfg. Co., Benton Harbor, Mich.
Studebaker Corp., South Bend, Ind. (Emil Schmidt, Fdy. Supt.)

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David Balcher, Owner, Balcher Machinery Co., Cleveland.
Thomas W. Gallagher, Personnel Mgr., Lake City Malleable Co., Cleveland.
Bruno Gburzynski, Fmn., Lake City Malleable Co., Cleveland.
Roscoe Hater, Melting Fmn., Malleable Fdy., Ohio Brass Co., Mansfield, Ohio.
John J. Hayes, Fmn., Lake City Malleable Co., Cleveland.
Stephen E. Linley, Pattern Engr., Eberhard Manufacturing Co., Cleveland.
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John W. Rendall, Fdy. Engr., Cooper-Bessemer Corp., Grove City, Pa.

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C. Robert Benedict, Massey-Harris Co., Brantford, Ont., Canada.
Robert Gray, Met., Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada.
Joseph Sully, Toronto, Ont., Canada.
Russell C. Vollick, Met. & Chief Chem., Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada.

OREGON CHAPTER

John F. Dettinger, Insp., Electric Steel Foundry Co., Portland, Ore.
Rolston W. Topping, Core Maker, Electric Steel Foundry Co., Portland, Ore.
J. C. Williams, Electric Steel Foundry, Portland, Ore.

PHILADELPHIA CHAPTER

Henry J. Yeager, Metallurgist (Consultant), Lancaster, Pa.

QUAD CITY CHAPTER

Paul Hay, Fmn., Fdy. Inspection, J. I. Case Co., Rock Island, Ill.
Capt. Quentin C. Soprano, Ordnance Dept., Rock Island Arsenal, Rock Island, Ill.

ROCHESTER CHAPTER

P. C. Buschner, Engineering Castings Div., American Brake Shoe Co., Rochester, N. Y.
H. J. Holst, Engineering Castings Div., American Brake Shoe Co., Rochester, N. Y.
Arthur Reed, Service Repr., George F. Pettinos, Inc., Philadelphia, Pa.
H. J. South, Engineering Castings Div., American Brake Shoe Co., Rochester, N. Y.

SAGINAW VALLEY CHAPTER

Albert R. Christian, Draftsman, Saginaw Malleable Iron Plant, G.M.C., Saginaw, Mich.
Howard L. Covert, Draftsman, Chevrolet Grey Iron Fdy., G.M.C., Saginaw, Mich.
John G. Essner, Draftsman, Chevrolet Grey Iron Fdy., G.M.C., Saginaw, Mich.
George A. Hach, Engr., Saginaw Malleable Iron Plant, G.M.C., Saginaw, Mich.
James R. Hannon, Engr., Saginaw Malleable Iron Plant, G.M.C., Saginaw, Mich.
Jacob F. Masker, Insp., Saginaw Malleable Iron Plant, G.M.C., Saginaw, Mich.
Waldo H. Neumann, Draftsman, Chevrolet Grey Iron Fdy., G.M.C., Saginaw, Mich.
Alois G. Schneider, Draftsman, Chevrolet Grey Iron Fdy., G.M.C., Saginaw, Mich.
John Suppes, Appr., General Motors Institute, Saginaw, Mich.

ST. LOUIS CHAPTER

J. F. Kohlberg, Chief Chemist, Great Lakes Carbon Corp., St. Louis.

SOUTHERN CALIFORNIA CHAPTER

Raymond D. Dorcey, Fdy. Supt., Quality Foundry, Vernon, Calif.
David B. Felch, Abrasive Engr., Pacific Grinding Wheel Co., S. Gate, Calif.
Dominic Troncale, Appr., Aluminum Brass Foundry, Los Angeles.

TENNESSEE CHAPTER

H. M. Freeman, Fdy. Fmn., Steel Plant, Ross-Meehan Foundries, Chattanooga, Tenn.

TEXAS CHAPTER

S. F. Anders, Chief Chemist, Lone Star Steel Co., Lone Star, Texas.
S. Glenn Anderson, Asst. Blast Furnace Supt., Lone Star Steel Co., Lone Star, Texas.
W. R. Bond, Gen. Mgr. of Oper., Lone Star Steel Co., Lone Star, Texas.
Dewey G. Burns, Supt. of Coke Plant, Lone Star Steel Co., Lone Star, Texas.
W. E. Fearn, Supt. of Cast Iron Pipe Plant, Lone Star Steel Co., Lone Star, Texas.
D. B. Hooser, Plant Engr., Lone Star Steel Co., Lone Star, Texas.
F. G. Stark, Blast Furnace Supt., Lone Star Steel Co., Lone Star, Texas.

TIMBERLINE CHAPTER

Lawrence E. Anderson, Asst. to Supt., Electron Corp., Fdy. Div., Littleton, Colo.
Philip H. Banister, Maint. Engr., Electron Corp., Fdy. Div., Littleton, Colo.
Donald R. Cole, Pattern Shop Fmn., Electron Corp., Fdy. Div., Littleton, Colo.
M. P. Drummond, Res. Engr., Colorado Fuel & Iron Corp., Chemical Div., Denver.
John L. Finlay, Jr., Fmn., Inspector, Electron Corp., Fdy. Div., Littleton, Colo.
A. C. Haynes, Maint. Engr., Electron Corp., Fdy. Div., Littleton, Colo.
George H. Langer, Fmn., Electron Corp., Fdy. Div., Littleton, Colo.
Axel W. Madsen, Engr., Electron Corp., Fdy. Div., Littleton, Colo.
Reginald A. Read, Jr., Sales Engr., Electron Corp., Fdy. Div., Littleton, Colo.
Vernon W. Scafinger, Fmn., Electron Corp., Fdy. Div., Littleton, Colo.
Harold Simmons, Supt. of Melting, Electron Corp., Fdy. Div., Littleton, Colo.
Harry Wilson, III, Lab. Control, Electron Corp., Fdy. Div., Littleton, Colo.

TRI-STATE CHAPTER

Carl P. Irwin, Sales Repr., Ingersoll-Rand Co., Tulsa, Okla.
Warren S. Sherman, Jr., Vice-Pres., Sherman Machine & Iron Works, Oklahoma City, Okla.

TWIN CITY CHAPTER

William H. Caldwell, Secy. Treas., Northern Malleable Iron Co., St. Paul.
Grant L. Eggen, Factory Repr., Joseph Dixon Crucible Co., Jersey City, N. J.
Lloyd H. King, Pres., King Foundry, Inc., Minneapolis.
Walter Schickel, Molding Fmn., Donovan, Inc., St. Paul.
W. D. Todish, Perfection Mfg. Corp., Minneapolis.

WASHINGTON CHAPTER

Stephen Forslund, Fdy. Fmn., Griffin Wheel Co., Tacoma.
Earl L. Holstrom, Atlas Foundry & Mach. Co., Tacoma.
A. C. Munro, Jr., Secy. & Treas., Seattle Foundry Co., Inc., Seattle.
James P. Murphy, Pres., Seattle Foundry Co., Inc., Seattle.
James W. Murphy, Appr., Seattle Foundry Co., Inc., Seattle.

WESTERN MICHIGAN CHAPTER

John Fialek, Melt. Fmn., Lakey Foundry & Machine Co., Muskegon, Mich.
John H. Gebbo, Layout Man, Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich.
Kenneth Kuehny, Clover Foundry Co., Muskegon, Mich.
A. M. Lieser, Sales Engr., Laclede Christy Co., Chicago.
Joe Volf, Melt. Dept. Supt., Campbell, Wyant & Cannon Foundry Co., Muskegon Heights, Mich.

WISCONSIN CHAPTER

Joseph John Broecker, Fdy. Met. Engr., J. I. Case Co., Racine, Wis.
Cherry-Burrell Corp., Sheboygan, Wis.—(Fred Ristow, Jr., Supt.).
Joseph E. Rogers, Core Room Supv., Badger Meter Co., Milwaukee.
R. J. Swartout, Vice-Pres., Belle City Malleable Iron Co., Racine, Wis.
Grant F. Thomas, Student, University of Wisconsin, Madison, Wis.

STUDENT CHAPTERS

MICHIGAN STATE COLLEGE

Gene Robert Rundell

UNIVERSITY OF ALABAMA

Lewis C. Gibson
E. Paul Hjorth
Herbert H. Jaeger

OUTSIDE OF CHAPTER

A. C. Brown, Pattern Supv., Draper Corp., E. Spartanburg, S. C.
Thomas M. Ecker, Pres. & Treas., Boston Electro Steel Casting, Inc., Boston.
Dennis F. Lombard, Fdy. Fmn., Bullard Co., Bridgeport, Conn.

INTERNATIONAL

England

Gordon Leonard Hancock, Gen. Mgr., The David Brown Foundries Co., Penistone, N. Sheffield, England.

India

Percy Eric Blincow, Fdy. Methods Engr., Burn & Co., Howrah, West Bengal, India.
William Mc Cormick Smith, Gen. Pmn., Burn & Co., Howrah, West Bengal, India.

Italy

Sig. Bottromei, Chief of Steel Fdy., Franco Tosi, Societa, per Azioni, Legnano, Italy.
Edoardo Capello, Dott. Ing., Consorzio Nax. Ghisa, Approvv. Materie Prime Per Fonderie, Milano, Italy.
Marino Selli, Engr., Officine Meccaniche di Savona Servettaz-Basevi, Liguria, Italy.
Societa Edison, Giunta Tecnica Biblioteca, Milano, Italy.

Japan

Masashi Makino, Chief Of Planning Dept., Ishikanajima Heavy Industries Co., Tokyo, Japan.

South Africa

E. D. B. Rush, Secy., South African Iron & Steel, Industrial Corp., Pretoria, South Africa.
Anthony Peter Alexander, Dir., Perfection Piston Mfg. (Pty) Ltd., Roodepoort TVL, South Africa.

South America (Argentina)

Francisco Mita, Gen. Mgr., Fundicion Mita, S. R. L., Cordoba, Argentina.
Miguel Angel Pucci, Ind. Engr., San Fernando S. R. L., Cia. Gral. de Fabricaciones, Buenos Aires, Argentina.

FOUNDRY Personalities

Howard H. Wilder, formerly chief metallurgist for the Eaton Mfg. Co.'s Foundry Division, Vassar, Mich., has been named manager of the Iron Foundry Division of the Vanadium Corp. of America, succeeding the late Richard G. McElwee, who died early this summer. Mr. Wilder, a past chairman of the A.F.S. Saginaw Valley Chapter, began his foundry career in 1930 with the Chevrolet Grey Iron Foundry, Saginaw, and worked in various Michigan foundries as metallurgist until 1942

H. H. Wilder

when he was appointed senior industrial specialist for the War Production Board. In 1943 he joined Vanadium Corp. of America as a foundry technician and was later research engineer for Wilson Foundry & Machine Co., Pontiac, Mich., prior to joining Eaton Mfg. Co. in 1946.

Whiting Corp., Harvey, Ill., at a meeting of its shareholders held at its main offices re-elected its entire roster of officers, headed by President **Stevens H. Hammond,** and the following directors: **Stevens H. Hammond, John Munro** and **J. Clyde Thomas,** all associated with the company; **Col. John Slezak,** president of Turner Brass Co.; **John B. Dunbar** of Shearson, Hammill & Co.; and **John W. Cavanagh,** partner of the corporation's counsel, McDermott, Will & Emery. At a meeting of the Board of Directors following the shareholders' meeting, **Fred M. Gillies,** executive vice-president of Acme Steel Co., was elected a director to fill the vacancy created by the recent death of General Thomas S. Hammond, chairman of Whiting's Board of Directors and a Past National President of the American Foundrymen's Society.

John Taylor, formerly vice-president and foundry division manager of Norris & Elliott, Inc., Columbus, Ohio, has been appointed vice-president in charge of the Industrial Engineering Division of Lester B. Knight & Associates, Inc., Chicago and New York consulting engineers. Mr. Taylor, who has had 27 years of industrial engineering experience, has spent the last 14 years as a professional foundry engineer, specializing in analyzing and improving methods, setting up production control and scheduling, payrolls, clerical routines and expense budgets. Mr. Taylor is the originator of a simplified standard cost system now in use in a number of foundries.

Alexander S. Wright, formerly metallurgist for the Hunt-Spiller Mfg. Corp., South Boston, Mass. and Standard Foundry Co., Worcester, Mass., will represent the Springfield Facing Co., Willimansett, Mass., in Massachusetts, Rhode Island, New Hampshire, Vermont and Maine.

Dr. Robert H. Steiner, formerly with the Firestone Tire & Rubber Co., has been appointed research coordinator for the Atlas Mineral Products Co., Mertztown, Pa. Dr. Steiner holds a B.S. cum laude and a Ph. D. from the University of Pittsburgh.

Richard A. Greene has joined Eastern Clay Products, Inc., Jackson, Ohio, as sales representative in the Northern Ohio area. A graduate of the University of Detroit, Mr. Greene was associated with Frederic B. Stevens, Inc., Detroit, from 1945 to 1948, when he joined the Harry W. Dietert Co., Detroit as a sales engineer. Mr. Greene has been an active member of the A.F.S. Detroit Chapter.

N. G. Sixt, formerly process engineer for the Carborundum Co., Niagara Falls, N. Y., has been named technical assistant to Fred P. Hauck, vice-president of the Michigan Abrasive Co. A graduate of Rensselaer Polytechnic Institute, Troy, N. Y., Mr. Sixt was formerly general manager of the Susquehanna Chemical Corp., New York, and holds the rank of Major in the U.S. Army Reserves Chemical Corps.

John Willard Horner, founder and president of the Slack-Horner Brass Foundry, Denver, for 37 years, is the author of an informal history of Georgetown, Colo., so-called "Silver Queen of the Seventies." Published by Caxton Printers, Ltd., Caldwell, Idaho, Mr. Horner's 319-page book, "*Silver Town*," is illustrated with old and rare photographs of the early West and is rich in interesting anecdotes and historical lore.

Andrew Liston has been named manager of the Hydraulic and Marine Turbine Products Department of the Baldwin Locomotive Works, Eddystone, Pa. Mr. Liston's activities will include handling of all products of the Baldwin brass and iron foundries. A graduate in Mechanical Engineering from Drexel Institute of Technology, Philadelphia, Mr. Liston became associated with the I. P. Morris Co. in 1929, and joined Baldwin when that firm was later purchased by Baldwin.

Howard B. Myers, formerly technical director for the Roll Manufacturers Institute, has been appointed metallurgical engineer for the S. H. Bell Co., Pittsburgh, where he will sell ferro-alloys and pig iron

H. B. Myers

produced by the Tennessee Products & Chemical Corp. Mr. Myers, who attended both Johns Hopkins University and the University of Pittsburgh, is a former Mellon Institute research fellow.

A. J. Grindle, a pioneer in the development and application of pulverized fuel for firing air furnaces and annealing ovens for the production of malleable castings, has been named consulting metallurgical engineer for the Whiting Corp., succeeding the late Alfred W. Gregg, A.F.S. Gold Medalist and chairman of the A.F.S. Educational Division, who died this spring. Mr. Grindle, who has been with Whiting for many years, will work closely with the company's sales force on problems involving product application and foundry mechanization. He will also be available to foundry groups and technical organizations as a speaker on foundry equipment and its applications.

James C. Zeder, director of research and engineering for the Chrysler Corp., Detroit, has been named a member of the National Inventors Council, an organization of prominent inventors and engineers which since 1940 has served the government by bringing its technical needs to the attention of independent inventors. Mr. Zeder has been selected to present the

Charles Edgar Hoyt Annual Lecture at the 1951 A.F.S. Convention in Buffalo.

Stockham Valves & Fittings, Birmingham, Ala., recently formed an Administrative Committee which will be charged with general direction of company affairs and whose purpose is to turn over part of top management's duties to younger men in preparation for the future. President **Herbert Stockham, Sr.,** and Vice-Presidents **Lester Shannon, Roy Stewart** and **Douglas Stockham** will make up the Administrative Committee, which will decide policies to be carried out by an executive group led by Vice-President **Richard Stockham,** assisted by heads of the company's four major departments: **C. H. Denicke,** general sales manager; **Harry M. Burns,** factory manager; **Thomas B. Noble,** treasurer; and **Reeves Sims,** personnel manager. These men will take over full responsibility for their respective departments under the new plan, which promotes them to top managerial standing.

Walter A. Funk, for the last six years foundry superintendent of the Reliance Foundry Co., Cincinnati and a veteran of some 40 years in the industry, recently retired and will live permanently in Delray Beach, Fla. Mr. Funk saw service with the Army in World War I, when he assisted in operating a foundry in France. He was foreman for 10 years and foundry superintendent for 12 years at Stedman's Foundry, Aurora, Ind., prior to joining Reliance Foundry Co.

OBITUARIES

Harold S. Arnold, 64, technical assistant to the president of International Nickel Co., died August 7. Mr. Arnold had been with International Nickel since 1914, when he became a member of the company's Physical Testing Laboratory in Bayonne, N. J. He had since been, successively, assistant to the superintendent of the Operating and Technical Department, assistant metallurgical engineer, production manager of the Huntington, W. Va., Works, technical assistant to the vice-president and to the president. In addition, Mr. Arnold acted as technical advisor on all films produced by International Nickel Co. in recent years.

Pete Stefan, 64, service engineer for Beardsley & Piper, Division of Pettibone Mulliken Corp., Chicago, and a veteran of more than 40 years in the foundry industry, died August 16. Born in Rumania, Mr. Stefan came to the United States in 1912 and settled in Alliance, Ohio. After working in the molding departments of several Midwestern foundries, he joined Beardsley & Piper's service organization in 1922 and had since visited hundreds of foundries throughout the country in his capacity as service engineer.

Henry A. Curtis, for the last 13 years metallurgist at Rock Island Arsenal, Rock Island, Ill., died July 22. Mr. Curtis took an active part in development of armor plate for World War II and was responsible for many improvements in aluminum castings for Army Ordnance applications.

A. F. S. CHAPTER DIRECTORY

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NORTHEASTERN OHIO CHAPTER *Secretary,* **A. J. Harlan, Hickman, Williams & Co., 1154 Union Commerce Bldg., Cleveland, O.**

NORTHERN CALIFORNIA CHAPTER *Secretary,* Davis Taylor, 90 Second St., San Francisco.

NORTHERN ILLINOIS-SOUTHERN WISCONSIN *Secretary,* Jack Rundquist, Beloit Casting Co., Beloit, Wis.

NORTHWESTERN PENNSYLVANIA CHAPTER *Secretary,* **Earl Strick, Erie Malleable Iron Co., Erie, Pa.**

ONTARIO CHAPTER *Secretary-Treasurer,* **G. L. White, Westman Publications, Ltd., 137 Wellington St. W., Toronto, Ont., Canada.**

OREGON CHAPTER *Secretary-Treasurer,* William M. Halverson, Electric Steel Foundry Co., 2141 N.W. 25th, Portland, Ore.

PHILADELPHIA CHAPTER *Secretary-Treasurer,* **W. B. Coleman, W. B. Coleman & Co., 9th and Rising Sun Ave., Philadelphia.**

QUAD CITY CHAPTER *Secretary-Treasurer,* R. E. Miller, 4115 7th Ave., Moline, Ill.

ROCHESTER CHAPTER *Secretary-Treasurer,* Duncan Wilson, American Brake Shoe Co., 10 Mt. Read Blvd., Rochester 11.

SAGINAW VALLEY CHAPTER *Secretary-Treasurer,* Walter F. Bohm, 329 W. Hamilton, Flint 4, Mich.

ST. LOUIS DISTRICT CHAPTER *Secretary,* Paul E. Retzlaff, Busch-Sulzer Bros. Diesel Engine Co., Div. Nordberg Mfg. Co., 3300 S. Second St., St. Louis 18.

SOUTHERN CALIFORNIA CHAPTER *Secretary,* **Harold G. Pagenkopp, Angelus Pattern Works, 2084 Belgrave Ave., Huntington Pk., Calfiornia.**

TENNESSEE CHAPTER *Secretary-Treasurer,* **Herman Bohr, Jr., Robbins & Bohr, Chattanooga Bank, Chattanooga, Tenn.**

TEXAS CHAPTER *Secretary,* John M. Morris, Lone Star Steel Co., P. O. Box 8087, Dallas 5, Texas.

TIMBERLINE CHAPTER *Secretary,* **James Schmuck, Rotary Steel Castings Co., 1425—5th St., Denver, Colorado.**

TOLEDO CHAPTER *Secretary-Treasurer,* R. C. Van Hellen, Unitcast Corp., 1414 E. Broadway, Toledo, Ohio.

TRI-STATE CHAPTER *Secretary,* C. C. Beagle, Webb Corp., Box 549, Webb City, Mo.

TWIN-CITY CHAPTER *Secretary-Treasurer,* **Lillian K. Polzin, Minneapolis Chamber of Commerce, 1750 Hennepin at Groveland Terrace, Minneapolis.**

WASHINGTON CHAPTER *Secretary,* **F. R. Young, E. A. Wilcox Co., 517 Arctic Bldg., Seattle 4, Wash.**

WESTERN MICHIGAN CHAPTER *Secretary,* Lauren Ramsey, Paul M. Weiner Foundry Co., Box 216, Muskegon, Mich.

WESTERN NEW YORK CHAPTER *Secretary,* **R. E. Walsh, Hickman, Williams & Co., 52 Eastwood Place, Buffalo, N. Y.**

WISCONSIN CHAPTER *Secretary,* J. G. Risney, Risney Foundry Equip. Co., 1507 N. 63rd St., Milwaukee 13.

STUDENT CHAPTERS

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40

9

Golfers and chowhounds acquiring one of those famous California sun tans at Southern California Chapter's Annual Outing, Lakewood Country Club, Long Beach, on Aug. 12. (Photo: Ken Sheckler, Calmo Engineering).

CHAPTER ACTIVITIES NEWS

Canton District

SEVENTH ANNUAL Picnic of the Canton District Chapter was held August 19 at the Mayfair Country Club, about 15 miles from Massillon, Ohio.

Featured activities of the outing were golf, softball, horseshoe pitching, penny pitching, a putting contest divided into competitions for golfers and non-golfers, cards, music and watching the Cleveland Indians on television. Climaxing the day's activities was a buffet ham dinner with free beer for all. Prizes contributed by some 50 foundry equipment and supply firms were awarded by ticket number and for sports events winners.

Mexico City

N. S. Covacevich
La Consolidada, S. A.
Chapter Secretary-Treasurer

FIRST MEETING of the A.F.S. Mexico City Chapter in its new quarters was held Wednesday, August 2, and was attended by some 136 foundry owners, managers, coremakers, molders, patternmakers, and other foundrymen from every foundry in Mexico City and surrounding cities and towns.

Opening the program was the showing of two films: Lynchburg Foundry Co.'s *"Men and Molds"* and the A.F.S. Aluminum & Magnesium Division's research films, *"Fluid Flow in Transparent Molds,"* showing the results of research conducted at Battelle Memorial Institute, Columbus, Ohio, under the sponsorship of the American Foundrymen's Society.

Following this, Henry Zimnawoda of National Engineering Co., Chicago, who was born in Europe and spent several years as a member of the staff of an elevator manufacturing firm in Sao Paolo, Brazil, addressed the meeting in Spanish on the subject, *"Six Ways to Mechanize a Foundry."*

Preceding this meeting, on July 26, the Chapter gave a dinner in honor of Chapter Chairman Fernando Gonzalez

A few of the several hundred foundrymen who forgot casting problems for a day at the Chicago Chapter's Annual Golf Party, held at the Lincolnshire Country Club, Crete, Ill. Left to right: John Lunkes, Trabon Co.; Knox Conely, LaPorte Foundry, LaPorte, Ind.; Victor Rowell, Trabon Corp.; Harry Swanson, Arrow Pattern & Foundry Co.; Ernest Reimann, Wisconsin Steel Co.; Roy Frazier, Howard Foundry Co., Leonard Colavegelo, Tractor Works, International Harvester Company; and Homer Beatty, Hill & Griffith Co.

Meeting on July 17 to discuss the program and plans for the Western Michigan Annual Picnic, August 19, were these Picnic Committee members.

With all due modesty, Harold A. Ziebell of Crucible Steel Castings Co., Milwaukee, holds up one finger symbolic of the hole-in-one he made during the Wisconsin Chapter's Outing at Ozaukee Country Club July 21. (Photo courtesy W. V. Napp, Badger Fire Brick & Supply, Milwaukee.)

Honored at a dinner given by the A.F.S. Mexico City Chapter July 26 were Chapter Chairman Fernando Gonzalez Vargas and Chapter Secretary-Treasurer N. S. Covacevich, both seated at head of table. The two chapter officers were feted for their work in promoting A.F.S. activities in Mexico.

Sports, fellowship and general relaxation were the order of the day at Northeastern Ohio Chapter's Annual Outing, held June 30 at Lake Forest Country Club near Cleveland. In photo at left are, left to right, Arthur J. Tuscany, Foundry Equipment Manufacturers' Association, A. L. Hingeman, and William E. Rayel, Archer-Daniels Midland Co. (Werner G. Smith Co. Division). Center: getting ready to sock one out of the park during the afternoon's softball game. Right: arguing over a close one are horseshoe experts Ray Stocker of National Malleable & Steel Castings Co., left and George Hayes of Stoller Chemical Co. (Photographs are courtesy of Sterling N. Farmer of Sand Products Corp., Cleveland.)

Officers and directors of the A.F.S. Mexico City Chapter flank Henry Zimnawoda (center), National Engineering Co., Chicago, who displayed his multilingual talents with a talk in Spanish at the August 2 meeting.

Vargas, Mexico City foundry consultant, and N. S. Covacevich of La Consolidada, S. A., Mexico City, Chapter secretary-treasurer, in recognition of their efforts to promote the work of A.F.S. in Mexico.

Twin City

J. D. Johnson
Archer-Daniels-Midland Co. (The Werner G. Smith Co. Div.)
Chapter Reporter

FIFTH ANNUAL GOLF PARTY of the Twin City Chapter was held at the Midland Hills Country Club Monday, July 31, with 183 members and guests enjoying an afternoon of golf and an evening of good food and fun. Success of the outing can be attributed to a hard working committee headed by Ted Palmer, Fire Brick Supply Co.

The following were first place winners in the golf tournament: Paul Kordiak, Jr., Scott Atwater Foundry Co., and Bob Tetzlaff, Modern Metals Foundry Co., members; and Harry

FUTURE CHAPTER MEETINGS

● ***SEPTEMBER 16***

BIRMINGHAM DISTRICT
Cascade Plunge, Birmingham, Ala.
ANNUAL OUTING
(Note: outing location changed because of fire at location originally scheduled)

NORTHWESTERN PENNSYLVANIA
Tieman's Grove and Lake Shore Golf Club, Erie, Pa.
ANNUAL PICNIC AND GOLF TOURNAMENT

ROCHESTER
Barnard's Firemen's Exempt Assn.
ANNUAL PICNIC

MICHIANA
Tabor Farm, near Sodus, Mich.
ANNUAL PICNIC

● ***SEPTEMBER 18***

QUAD CITY
Ft. Armstrong Hotel, Rock Island, Ill.
E. C. ZIRZOW
Deere & Co.
"Foundry Molding Sands and Core Sands"

OREGON
Heathman Hotel, Portland
T. E. BARLOW
Eastern Clay Products, Inc.
"Sand Control"

● ***SEPTEMBER 21***

BRITISH COLUMBIA
Pacific Athletic Club, Vancouver
T. E. BARLOW
Eastern Clay Products, Inc.
"Cupola Practice"

● ***SEPTEMBER 22***

CHESAPEAKE
Columbia and York, Pa.
Plant Visitation to Columbia Malleable Iron Co. and York Corp. during day and meeting in evening.

● ***SEPTEMBER 22***

TENNESSEE
Hotel Patten, Chattanooga
Speaker to be announced.
"Metallurgy of Gray Iron"

● ***SEPTEMBER 25***

NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
S. F. CARTER
American Cast Iron Pipe Co.
"Basic Lined Cupola"

● ***SEPTEMBER 28-30***

EASTERN CANADA
ONTARIO
Hamilton, Ont.
ALL CANADIAN FOUNDRY CONFERENCE

● ***OCTOBER 2***

METROPOLITAN
Essex House, Newark, N. J.
B. N. AMES
New York Naval Shipyard
"Plastic Bonded Thin-Shelled Molds"

CENTRAL ILLINOIS
American Legion Post 2, Peoria, Ill.
W. H. FRANKLIN
Caterpillar Tractor Co.
"What Makes Business Tick"

● ***OCTOBER 2***

WESTERN MICHIGAN
Cottage Inn, Muskegon
WILLIAM T. BEAN
Industrial Electronics, Inc.
"Sound Castings CAN Be Engineered"

Mexico City Chapter's August 2 meeting, the first held in its new location, drew 136 foundrymen to hear Henry Zimnawoda, National Engineering Co., Chicago, describe "Six Ways to Mechanize a Foundry" in Spanish.

Randolph, winner among the guests.

Highlight of the afternoon on the golf course was the drenching thundershower that caught most of the golfers with their raincoats at home.

Group singing before and during the dinner hour was accompanied by Kathy and her accordion. After dinner many valuable prizes were raffled. The affair was greatly enjoyed by everyone.

Southern California

S. L. Jackson
Electro Metallurgical Div., Union Carbide & Carbon Corp.
Publicity Chairman

THIRTEENTH Annual Outing of the Southern California Chapter, held at the Lakewood Country Club, Long Beach, on August 12, featured golfing, dinner and an excellent program of professional entertainment and was attended by several hundred foundrymen and their guests.

Succulent roast beef was a feature attraction of the dinner menu at Wisconsin Chapter's Annual Outing, held at the Ozaukee Country Club July 21. (Photo courtesy of Walter V. Napp, Badger Fire Brick & Supply Co.)

FUTURE CHAPTER MEETINGS

● **OCTOBER 4**

MEXICO CITY
Chemical Engineers Society Bldg.
ANNIVERSARY MEETING
(Plant visitations plus general program)

● **OCTOBER 5-6**

TEXAS
TEXAS A & M STUDENT CHAPTER
Plaza Hotel, San Antonio
TEXAS REGIONAL FOUNDRY CONFERENCE

● **OCTOBER 9**

MICHIANA
Alby's Steak House, South Bend, Ind.
E. H. REED
International Harvester Co.
"Selection and Education of Trainees"

● **OCTOBER 11**

MO-KAN
Fairfax Municipal Airport, Kansas City, Mo.
F. S. BREWSTER
Harry W. Dietert Co.
EVENING SAND SCHOOL

● **OCTOBER 12**

NORTHEASTERN OHIO
Tudor Arms Hotel, Cleveland
G. A. ZANG and F. E. CHITTENDEN
Unitcast Corp.
"Let's Pretend"

● **OCTOBER 13-14**

WASHINGTON
BRITISH COLUMBIA
OREGON
OREGON STATE COLLEGE
Gowman Hotel, Seattle
NORTHWEST REGIONAL FOUNDRY CONFERENCE

● **OCTOBER 13**

PHILADELPHIA
Engineers Club of Philadelphia
Afternoon: Plant visitation to Philadelphia Coke Co.
Evening: B. P. MULCAHY
Fuel Research Laboratories, Inc.
"Cupola Practice"

WISCONSIN
Schroeder Hotel, Milwaukee
SECTIONAL MEETING

● **OCTOBER 13**

TRI-STATE
Joplin, Mo.
F. S. BREWSTER
Harry W. Dietert Co.
EVENING SAND SCHOOL

● **OCTOBER 19**

TWIN CITY
Covered Wagon, Minneapolis
F. G. SEFING
International Nickel Co.
"Structure Control vs. Wear Resistance of Cast Irons"
Joint meeting with Northwest Chapter ASM

● **OCTOBER 27**

TENNESSEE
Hotel Patten, Chattanooga
EARL E. WOODLIFF
Sand Consultant
"Foundry Sand and Sand Control"

Over 600 foundrymen enjoyed themselves at the Wisconsin Chapter's Annual Outing at the Ozaukee Country Club July 21. Shown is the outdoor refreshment tent. (Photo courtesy of Clyde R. Ethier, Pendergast Sand Co.)

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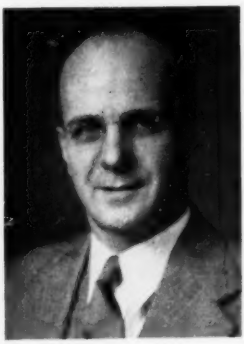
Texas Chapter



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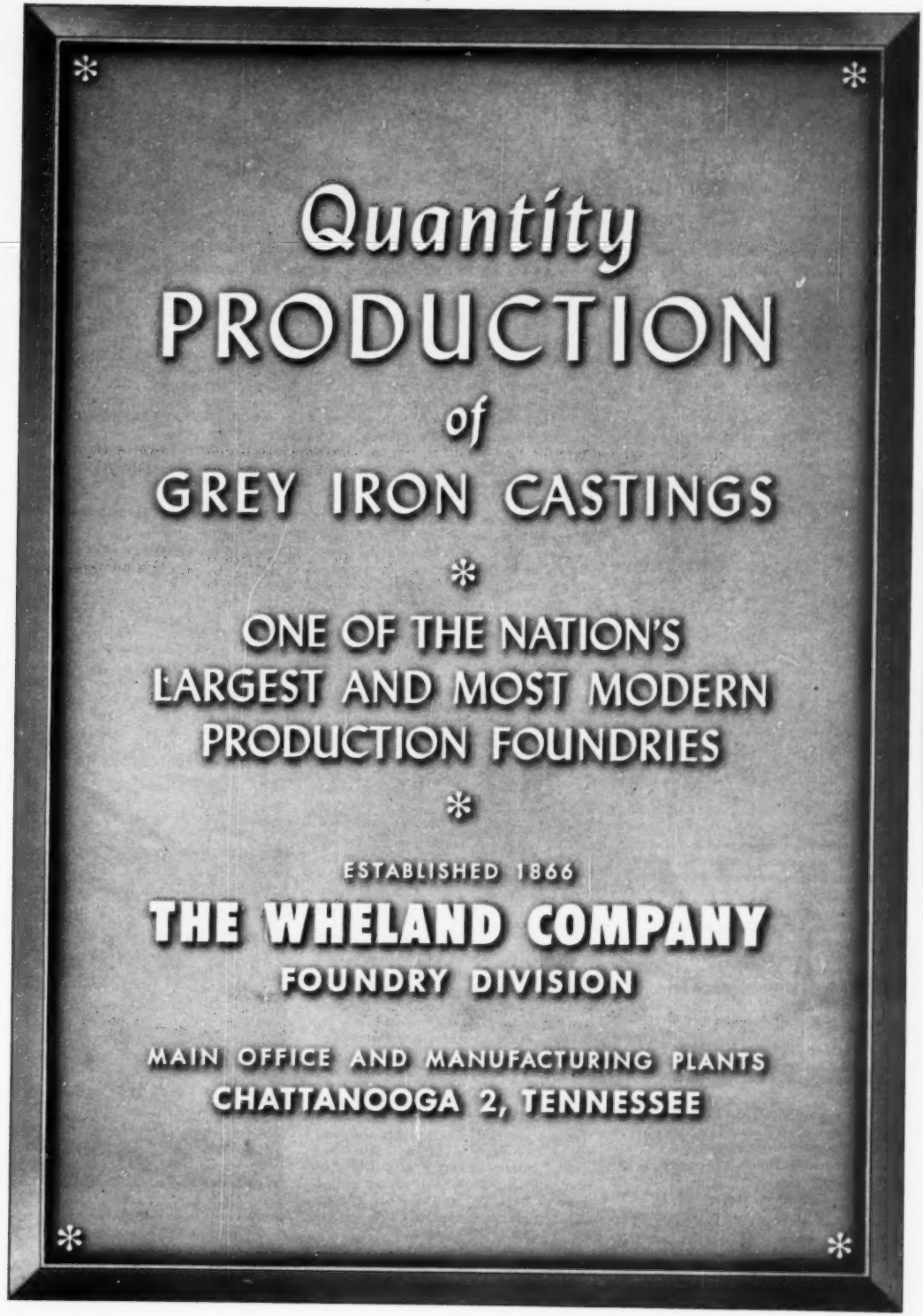
Quantity
PRODUCTION
of
GREY IRON CASTINGS
ONE OF THE NATION'S
LARGEST AND MOST MODERN
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ESTABLISHED 1866
THE WHELAND COMPANY
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CHATTANOOGA 2, TENNESSEE

NEW Foundry Products

Readers interested in obtaining additional information on items described in New Foundry Products should send requests to Reader Service, American Foundryman, 616 S. Michigan, Chicago 5, Ill. Refer to the items by means of the convenient code numbers.

Portable Muller

SP1—Low-cost, lightweight and extremely portable, the Cincinnati Muller, introduced at the 54th A.F.S. Foundry Congress & Show in Cleveland, handles small batches of sand up to 7 lb either in the foundry

or the laboratory. Sturdily constructed with only two moving assemblies, unit is easily cleaned and reassembled. *Buckeye Products Co.*

Hardfacing Alloy

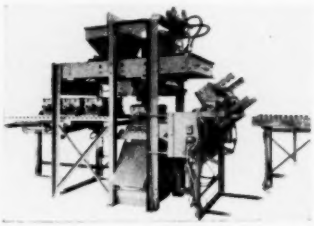
SP2—New hardfacing alloy, Aircolite 59, is designed primarily for applications involving high stress abrasion with medium impact. Cast in rod form, Aircolite 59 is composed principally of chromium, molybdenum, carbon and iron and has a low coefficient of friction, thus acquiring high polish in service. Deposit maintains high hardness at temperatures up to 800 F. Manufacturer recommends alloy for building up surfaces subject to high stress abrasion and metal-to-metal friction where impact is moderate and abrasion severe. *Air Reduction Sales Co.*

Moisture Tester

SP3—Moisture tester makes rapid, accurate and automatic determination of moisture in foundry sands and other materials and may be used in the foundry or at any other location where electrical connection can be made. Employing the gravimetric principle, tester uses radiated heat to dry sample quickly. Definite weight of material is weighed on scale pan, sample is dried with aid of heat bulb and moisture is indicated directly on dial. Procedure is foolproof and requires only two to five minutes for complete test, depending on moisture content of material. *Claud S. Gordon Co.*

Automatic Mold Machine

SP4—Series 2000 fully-automatic molding machine produces up to 300 drag-molds per hour and features a straight-through production cycle, minimum number of working parts, accurate control and consistent production of high-quality molds. Operating on 80 psi line pressure and solenoid-valve controlled, unit has three-button operation: (1) single-cycle operating through complete cycle to pro-



duce one drag-mold; (2) repeat-cycle providing for continuous automatic operation, and (3) master switch to stop machine instantly. In production, standard conveyor feeds empty flasks, which are pulled to position over pattern, lowered, charged and jolted. As metering box assembly returns to refill and pick up another flask, tandem-mounted squeeze head is positioned over first flask, squeezes flask and stripping operation begins as squeeze head retracts. Upon completion of strip, metering box rolls second flask into position and pushes flask with completed mold toward roll-over mechanism. Air blast cleans pattern as empty flask is pulled into position. Illustrated model accommodates 14 x 26 in. flasks, has 1,000-lb capacity jolt mechanism, 20,000-lb squeeze and 8-in. draw. *Spo, Inc.*

Antiseptic Floor Detergent

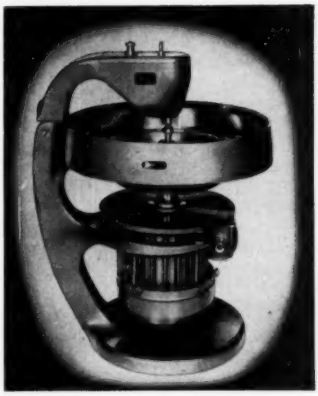
SP5—"First," an antiseptic liquid detergent for floors, cleans, sanitizes and deodorizes in one operation. Eliminates odors, mold, mildew and kills fungus as well as gram positive and gram negative bacteria, leaving no disinfectant odor. Recommended by manufacturer for office, industrial, rest room and plant cafeteria floors, "First" is premixed in the proper proportion of cleaner to germicide and will not harm the finest floors. *Piatt & Smille Chemicals, Inc.*

Abrasive Discs and Holders

SP6—Introductory Press-On Trial Kit contains three flexible disc holders of ¾, 1 and 1½ in. diameters with three sets of abrasive discs to fit holders. Flexible rubber disc holders containing standard threaded inserts molded into base for acceptance of threaded mandrels of any desired length, make for easy handling of cavities up to 12 in. Abrasive discs for grinding and polishing contoured surfaces are attachable to holder in a few seconds and conform easily to contour, providing excellent finish. *Metal Removal Co.*

Micro-Particle Classifier

SP7—Bacho Micro-Particle Classifier, marketed under license from Sweden, is a precision laboratory unit for determining



the fineness of materials ranging from 0 to 100 microns. Classifier may be used to test materials passing through U. S. Standard 140 Test Sieve. Sample may be divided into eight or more particle size separations

(Continued on Page 79)

Advertisement

ELECTROMET Data Sheet

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Division, Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

How Manganese Briquets Control Sulphur . . . Produce Cleaner, Sounder Iron Castings

The use of manganese briquets in the cupola charge provides a convenient and accurate method of controlling this important element in cast iron. Accurate control of the manganese level is essential for the consistent production of high-quality iron. While manganese will be introduced in varying amounts by the pig iron and scrap, a supplementary source—such as manganese briquets—is usually essential if accurate analysis control is to be maintained.

Manganese has two important functions in cast iron:

1. It acts as a sulphur-neutralizing element when used in small amounts — up to roughly six times the sulphur content.
2. It acts as an alloying element, imparting density and strength when present in amounts greater than necessary to perform its desulphurizing function.

Neutralizes Sulphur

Cast iron tends to run considerably higher in sulphur than was the case a decade ago because there has been an increase in the sulphur content of both scrap and foundry coke in recent years. Unless sufficient manganese is provided in the cupola mixture, this higher sulphur content will tend to produce a hard, brittle metal with deep chilling properties and poor fluidity. Castings of such metal are difficult to machine and may be the cause of many foundry troubles, including strain cracking, chilled corners and edges, and misrun castings.

Since manganese has a high affinity for sulphur, it forms manganese-sulphide inclusions when present in sufficient amounts. These inclusions are relatively harmless to the metal, and the detrimental effects of the sulphur content are thus largely eliminated. It is good practice to maintain a manganese-sulphur ratio of approximately 6:1 to insure proper neutralization of the sulphur content.

A certain proportion of the manganese-sulphide that is formed will float to the surface of the molten iron and be absorbed by the cupola slag. In this way, manganese actually eliminates a portion of the sulphur introduced by cupola melting. Thus, relatively high manganese irons will invariably run lower in sulphur than will metal melted from similar raw materials but of lower manganese content.

Sounder Castings

The cleansing effect of manganese is a decided help in producing a high-quality foundry product with a minimum amount of trouble from porosity, shrinks, and blows. Manganese helps to neutralize gassy metal that may result from temporarily unbalanced cupola conditions or poor-quality melting materials. It improves the fluidity of iron that may be a little on the cold side or high in sulphur. Manganese does a general cleansing job that is helpful in avoiding slag inclusions, which have a detrimental effect on machinability.

Alloy Effects

When manganese is used in amounts greater than that necessary to neutralize sulphur, it acts as a desirable carbide-stabilizing alloy in cast iron. Depending on the amount added and other elements present, manganese tends to refine pearlite and, at higher levels, to form martensite. Increasing the normal percentage of manganese in cast iron to 1 per cent or above will often change a normally ferritic-pearlite matrix to the stronger all-pearlitic structure.

Two Types of Briquets

ELECTROMET produces two types of manganese briquets — EM silicomanganese briquets and EM ferromanganese briquets. The silicomanganese type is square in shape and contains exactly 2 lb. of manganese and about ½ lb. of silicon. Ferromanganese briquets, which are oblong in shape, also contain exactly 2 lb. of manganese, but do not contain silicon.

The recovery of manganese from EM manganese briquets normally runs about 85 per cent, because the briquets are made with a binder that prevents oxidation until the alloy unites with the iron in the melting zone of the cupola.

A typical mixture for high-strength iron is given in the accompanying table. For further information—

SEND FOR FREE BOOKLET

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Technical Service Department
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Please send me a copy of the booklet "Briquetted Alloys for the Iron Foundry Industry".

Name ..... Position .....

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Typical Cupola Charge for Producing High-Strength Iron With EM Briquets

Base Charge			Alloys in Charge Material			
			Silicon		Manganese	
%	Lb.	Material Charged	%	Lb.	%	Lb.
15.0	150	Pig Iron	2.30	3.45	0.70	1.05
40.0	400	Steel Scrap	0.10	0.40	0.45	1.80
35.0	350	Return Scrap	1.90	6.65	1.00	3.50
10.0	100	Purchase Scrap	2.00	2.00	0.45	0.45
100.0%	1,000 lb.	Total Base Charge		12.50		6.80
Briquets Required		7½ Small Silicon		7.50		—
		2½ Silicomanganese		1.25		5.00
		Total Alloys Charged		21.25 lb. Si. or 2.12% Si.		11.80 lb. Mn. or 1.18% Mn.
		Melting Recovery Factor		x .90		x .85
		Final Analysis of Iron		1.90% Si.		1.00% Mn.

New.... Improved

DELTA CORE & MOLD WASHES

SPEED PRODUCTION OF BETTER, CLEANER CASTINGS AT *Lower Cost*

Three easy-to-understand reasons why more foundries use DELTA Core and Mold Washes . . .

1. **MORE PERFECT CASTINGS . . .**
2. **LOWER CLEANING ROOM COSTS . . .**
3. **LESS SCRAP IN MACHINING.**

DELTA CORE AND MOLD WASH-BASE
Mix with silica flour and water to produce finished wash.

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FOR STEEL
STEELKOAT — Special Core and Mold Wash.

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FOR GRAY IRON AND MALLEABLE
Grakoat — Blackoat — Hi-temp.

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FOR GRAY IRON
Blackoat S-5 — A new and different wash.

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FOR NON-FERROUS METALS
Non-FerrusKoat.

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FOR ALL SAND CAST METALS
THERMOKOAT — It's Plasti-Lastic.
PYROKOAT-HI-Speed.

•

FOR UNUSUALLY HIGH TEMPERATURE CONDITIONS
Z-KOAT — High-fusion-temp. Wash.

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There is no "just as good" substitute for any DELTA Core and Mold Wash just as there is no substitute for DELTA'S scientific laboratory control of production which safeguards the quality and uniformity of all DELTA Foundry Products. DELTA Research laboratories developed, and pioneered the use of, Plastic-type Core and Mold Washes . . . and still leads the field in the development of new products for improved foundry practices.

NEW mechanical processing and improved chemical formulation . . . developed by DELTA Research . . . have resulted in many decided advancements in both the quality and characteristics of DELTA CORE and MOLD WASHES.

Maximum uniformity of surface coverage is obtained with lower Beaume mixes, using more water. Penetration characteristics are THREE times greater (from 10 to 12 grains deep) and the density of the wash on the surface has been increased 40%.

Due to increased surface density the rate heat conductivity is speeded up and metal in contact with the washed surfaces cools more rapidly, resulting in smoother casting finish.

HERE'S WHY

a. Delta Core and Mold Washes "Anchor" themselves by penetrating from 10 to 12 grains deep into the sand. This bond between the wash and the sand . . . a distinctive DELTA characteristic . . . produces an expansion-resisting coating essential to the production of finer finished castings.

b. The hot strength of Delta Core and Mold Washes increases with each degree of temperature rise from 1800°F to 3000°F providing maximum critical hot strength for all foundry applications.

The higher hot strength of DELTA Core and Mold Washes eliminates surface sand fissuring, excessive sand expansion and distortion.

c. No gas leakage through Delta Core and Mold washed surfaces. Gases produced by decomposition of organic binders in the core sand cannot leak through Delta Core and Mold washed surfaces to contact the molten metal. Only Delta Core and Mold Washes provide this unique and all-important insurance against defective castings resulting from core gas leakage. DELTA Core and Mold Washes insure more perfect castings with finer finished surfaces.

● *Ask for a liberal working sample. You will also receive complete data on how to use DELTA Core and Mold Washes in your foundry.*

DELTA OIL PRODUCTS CO.

MILWAUKEE 9, WISCONSIN

NEW PRODUCTS

(Continued from Page 76)

by passing it through classifier. Each separation is caught in metallic container for weighing and calculation of percentages. Separations may be retained for chemical analysis or microscopic study. Classifier works on principle of Stokes Law (air centrifuge separating particle sizes by air velocities) and may be used to determine fineness of smoke particles, industrial dust, chemicals and other finely-ground materials. *Harry W. Dietert Co.*

Wood Cereal Binder

SP8—Designed for use in steel foundry molding sands, Masonoid, a spray-dried, hemicellulose extract, is a water soluble powder derived from steam explosion and hydrolysis of southern woods and is claimed by manufacturer to be more economical than corn cereal. Other advantages claimed are: (1) improved flowability (2) improved shakeout properties (3) produces even ramming (4) reduces cleaning costs (5) reduces fines and allows use of greater proportion of reworked sand (6) reduces bentonite requirements (7) maintains good permeability and strength in reworked sands, and (8) minimizes need for mold washes and intensive torch drying in air dry sands. Shipped in 50-lb, multi-ply paper bags. *Masonite Corp.*

Portable Inspection Unit

SP9—New, portable Magnaflux unit KH-05 builds up a magnetic particle indication by quick magnetization to detect invisible fatigue cracks, shrink cracks, weld cracks, etc. Portable enough to be carried in car trunk, Model KH-05 is mounted on rubber-tired wheels for inspection of equipment in place. Accessory compartment contains powder and necessary materials. Magnetizing coil is looped around part to be inspected. Operation

is controlled by single switch on control panel, which carries meter reading in true magnetizing amperes and indicator light to show when magnetizing current is available on cable. *Magnaflux Corp.*

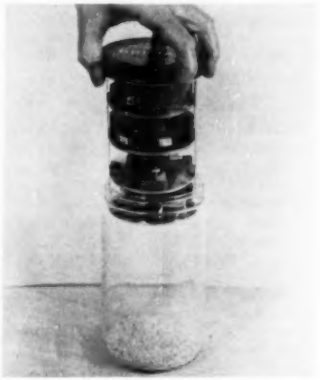
Burden Carrier

SP10—ToteMaster Burden Carrier has 2000 lb capacity, with 21 sq ft of loading space and is powered by 20 hp, four-cylinder, high-compression engine. Other features of this materials handler are hydrau-

lic airplane brakes, pneumatic tires, T handle steering, seat-operated parking brake, two-wheel drive through automotive differential. Three speeds forward and one reverse save strain on engine and increase grade performance with heavy loads. *Lewis-Shepard Products, Inc.*

Specimen Storage Jar

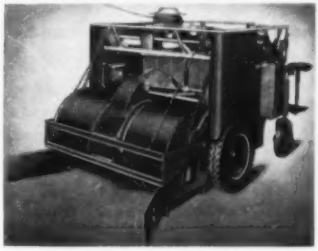
SP11—Dri-Jar dries, stores and files laboratory specimens. Apparatus consists of



wide-mouthed glass jar 3 in. in diameter and 7 in. high with screw lid. Rigidly suspended from lid is series of four metal storage shelves, on which material can be placed uncovered, boxed or otherwise separated, tabulated and marked for easy reference. Specimens can be seen through glass and are available without disturbing others. *Bethlehem Apparatus Co.*

Portable Sand Conditioner

SP12—Easily maneuverable Sandmaster performs cutting, magnetic separation, screening and foundry molding sand piling operations. Uniquely-designed cylinder cuts, mixes and mulls sand, leaving it fluffy, aerated and cool and with excellent flowability. Synthetic sands are conditioned quickly and with less bond additions. Machine removes shot and tramp



metal by magnetic separation, screens all other foreign material and piles sand at molders' benches. Reversible scrapers eliminate manual trimming. Hydraulically steered, unit can be supplied with either gas or electric drive with variable speeds from 4 to 25 fpm for cutting and screening, and 25 to 100 fpm when piling. *American Wheelabrator & Equipment Corp.*

Electric Chain Hoists

SP13—Complete improved line of electric roller chain hoists features simple, totally-enclosed, double worm gear drive, plus spring-set, shoe-type motor brake with lining bonded to shoe for greater braking power and longer brake life. Pull cord is located at center of hoist frame to eliminate tipping. Hoist control switch is protected from damage. Hoists are available in ¼, ½, 1 and 2-ton capacities. *Whiting Corp.*

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FOUNDRY Literature

Readers interested in obtaining additional information on items described in Foundry Literature should send requests to Reader Service, American Foundryman, 616 S. Michigan Ave., Chicago 5, Ill. Refer to the items by means of the convenient code numbers.

Dust Suppression

SP101—Two bulletins describe dust suppression equipment (1) Bulletin FY-166, giving functions and dimensions for Hydro-Clone manual and automatic sludge-setting tanks, and (2) Bulletin FY-167, describing a variety of Hydro-Clone installations under varying conditions. *Whiting Corp.*

Airless Blasting

SP102—24-page booklet explains Wheelabrator method of airless blasting, types of machines available and discusses application to metal cleaning, finishing and shot peening problems. Typical parts cleaned and actual installations are shown through mediums of photographs, line drawings and diagrams. *American Wheelabrator & Equipment Co.*

Chrome Bonding Cement

SP103—4-page brochure explains composition, properties and applications of Kromepatch chrome bonding cement. Features: workability, high air-set strength, continuous bonding action, slag resistance, P.C.E. of 3290 F. *E. J. Lavino & Co.*

Mechanized Metal Pouring

SP104—Broadside containing case study report based on ferrous and non-ferrous metal pouring in hot weather is of primary interest to foundry superintendents. Described are applications of Model FA pouring machines, which convey metal over monorail to pouring floor crane. Second crane trolley hoists poured molds to conveyor and on way to shakeout pit. *Modern Equipment Co.*

Modernizing Sand Mixers

SP105—4-page Bulletin 503 tells how to reduce operating costs and increase production by adding latest improvements to existing mullers. Ten simple ways of modernizing existing equipment in the foundry with a minimum of labor and expense are given in the booklet. *National Engineering Co.*

Materials Handling

SP106—72-page guide for analysis of materials handling operations and the application of unit-load method with power-operated industrial trucks and accessories. "*Handbook of Materials Handling*," is entirely new in context, illustrations, charts and data and supplants the formerly-published "*Materials-Handling Handbook*." One copy free to company executives or engineering school deans and professors requesting it on company or institutional letterhead. Price: $1. *Electric Industrial Truck Association, Dept. PR.*

Test Core Maker

SP107—Descriptive sheet outlines construction details, operation and advantages of the Gordon-Campbell transverse test core maker, used in preparing standard test specimens for investigation of core materials and core baking practices. *Claud S. Gordon Co.*

Annealing Furnaces

SP108—4-page bulletin on malleable iron annealing furnaces contains photographic illustrations, sectional drawings and descriptions of various models. Also illustrated and described is low-hydrogen gas generator for controlled atmosphere malleable annealing. *Holcroft & Co.*

Testing Machine

SP109—Illustrated catalog No. RU-3-50 describes low-cost Model MA Universal Hydraulic Testing Machines and includes details of construction, specifications and dimensions. *Riehle Testing Machines Div., American Machine & Metals, Inc.*

Metal Inspection Dye

SP110—Folder describes procedures, properties and applications of Dy-Chek, a dye penetrant chemical process for manufacturing inspection, receiving inspection and preventive maintenance. *Dy-Chek Co., Div. of Northrop Aircraft, Inc.*

Lift Trucks

SP111—Two 4-page folders give specifications, dimensions, capacities and mechanical details of hand lift trucks. Red Arrow bulletin covers six models of single-stroke mechanical lift trucks with 2500 to 5000 lb capacities. Hydromatic folder describes six models of fluid ram lift trucks with capacities to 8000 lb. *Lift Trucks, Inc.*

Bronze Alloys

SP112—4-page pamphlet describes properties, characteristics and applications of Herculoy Engineered Bronzes, copper-silicon alloys similar to high tin bronzes but free of tin. Tabulations are also given of physical properties for two types of alloys. *Federated Metal Div., American Smelting & Refining Co.*

Core Materials

SP113—Sands, moisture and binders and how they affect foundry cores are the subject of a 12-page illustrated folder. Color charts show properties of various sands at three different moisture levels, the effects of binders on cores, and the part mixing procedure plays in core-making. "Sands, Moisture, Binders" booklet is condensation of several research reports. More detailed information is also available from *Archer-Daniels-Midland Co. (The Werner G. Smith Division).*

(Continued on Page 92)

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GLOSSARY

(Continued from Page 64)

plaster pattern—A pattern made from plaster of Paris.

pattern record card — A filing card giving description, cost, location in storage, and movement of a pattern.

pearlite—Lamellar aggregate of ferrite and carbide in the microstructure of iron and steel.

pearlitic malleable cast iron—The product obtained by a heat treatment of white cast iron which converts some of the combined carbon into graphite nodules but which leaves a significant amount of combined carbon in the product.

peen — Flat-pointed end of a rammer used in ramming sand into a mold.

peg gate — A round gate leading from a pouring basin in the cope to a basin in the drag, whence sprues lead to the mold.

penetration, metal — A casting surface defect which appears as if the metal has filled the voids between the sand grains without displacing them.

periodic annealing furnace—A furnace in which the castings pass through a complete cycle of preheating, soaking, and cooling.

peritectic transformation—The transformation of delta iron plus liquid metal, depending on the carbon content, into the solid phase of delta plus gamma iron, or gamma iron, or to gamma plus liquid melt phase. This transformation takes place at 2715 F.

permanent mold — A mold, ordinarily of metal, used repeatedly for production of many castings of the same form; liquid metal is poured in by gravity; not an ingot mold.

permeability (sand) — A measure of that physical property which permits gas to pass through the molded mass of sand.

phase — A physically homogenous portion of a material system.

phase diagram—A graphical representation of the equilibrium temperatures and composition limits of phase fields and phase reactions in an alloy system. In a binary system, temperature is usually the ordinate and composition the abscissa. Ternary and more complex systems require several two-dimensional diagrams to show the temperature-composition variables completely. In metal systems, pressure is usually considered constant, although it may be treated as an additional variable.

phosphorus—One of the elements, with the chemical symbol P.

photomicrograph — A photographic reproduction of any object magnified more than 10 diameters. The term micrograph may be used.

pickle — Chemical or electrochemical removal of surface oxides from metal surfaces.

pig—An ingot of virgin or secondary metal to be remelted for use.

pig bed — Small excavations or regularly made open-sand molds in the floor of the foundry, to hold the excess iron in the heat.

pig iron—Cast iron generally produced by the reduction of iron ore in a blast furnace.

pig machine — An endless belt of metal molds filled with iron from blast furnace ladle.

pinhole porosity — Very small holes scattered through a casting, possibly by microshrinkage or gas evolution during solidification.

pipe — A cavity formed by contraction in metal during solidification of the last portion of liquid metal as in a riser.

plugged impressions — Impressions formed by inserting a plug of required shape through a pattern into the sand.

plumbago — Graphite in powdered form. Plumbago crucibles are made from this graphite plus clay.

porosity—Unsoundness caused in cast metals by presence of blowholes and shrinkage cavities.

porosity (sand)—Volume of the pore spaces or voids in a sand.

pot—A vessel for holding molten metal.

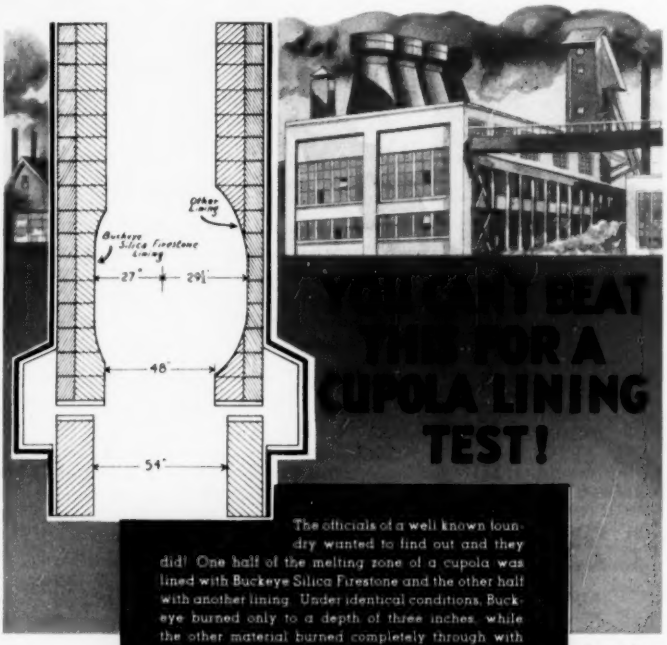
poured short — Casting which lacks completeness due to the mold not being filled.

pouring — Transfer of molten metal from ladle into molds.

pouring basin—A basin in the cope to hold molten metal prior to its entrance into the gate.

precipitation hardening — A process for hardening an alloy in which a constituent precipitates from a supersaturated solid solution. See AGE HARDENING and AGING.

precipitation heat treatment — In nonferrous metallurgy, any of the various



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aging treatments conducted at elevated temperatures to improve certain mechanical properties through precipitation from solid solution. See ARTIFICIAL AGING, INTERRUPTED AGING, and PROGRESSIVE AGING.

precision investment casting — A casting made by the lost wax process.

pressure-tight — A term that describes a casting free from porosity of the type that would permit leaking.

primary crystals—The first dendritic crystals that form in an alloy during cooling below the liquidus temperature.

production foundry—A foundry engaged in manufacture of castings in large quantities, usually highly mechanized to minimize manual labor. See JOBBING FOUNDRY.

progressive aging — An aging process in which the temperature of the alloy is continuously increased during the aging cycle. The temperature may be increased in steps or by any other progressive method. Compare with *interrupted aging*.

prop—An iron post used to support the bottom doors of the cupola.

proportional limit—The greatest stress which a material is capable of developing without deviation from the law of proportionality of stress to strain.

pull cracks—Cracks caused in a casting by thermal contraction when two portions become anchored as a result of an irregular shape. See HOT TEAR.

pull down—A buckle in the cope, sometimes severe enough to cause a scab.

push-up — An indentation in the casting surface due to displacement of sand in the mold.

pyrometer—An instrument of any of various types used for measuring temperatures.

pyrometer tube — A metal or a ceramic tube sealed at one end, containing the thermocouple for measurement of temperatures.

pyrophoric alloys—Alloys that emit sparks when struck or abraded, usually iron-cerium alloys; used in cigarette lighters.

Q

quench hardening—Process of hardening a ferrous alloy of suitable composition by heating within or above the transformation range and cooling at a rate sufficient to increase the hardness substantially. The process usually involves the formation of martensite.

quenching—A process of rapid cooling from an elevated temperature by contact with liquids, gases or solids.

quenching crack—A fracture resulting from thermal stresses induced during rapid cooling or quenching. Frequently encountered in alloys that have been overheated and liquidated and are thus "hot short."

R

radioactive metals—A group of metals with high atomic weights and with atomic nuclei that decompose slowly, giving off continual radiations of positively charged alpha particles, which are relatively slow; negatively charged beta particles, which are faster and lighter; and gamma rays. The gamma rays are similar to x-rays but are more pentrating and are used for radiography of very

(Continued on Page 85)

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FOUNDRY FIRM Facts

Electro Metallurgical Div., Union Carbide & Carbon Corp., New York, announces that it will have a new plant for the production of electrolytic chromium in operation at Sault Ste. Marie, Mich., by spring of 1951. The chromium plant will adjoin Electro Metallurgical's present facilities there for production of calcium carbide. The electrolytic chromium operation will be based on an entirely new process developed by the Bureau of Mines and Union Carbide & Carbon Corp. laboratories. Principal use of electrolytic chromium is in non-ferrous alloys for metal-cutting tools, electrical applicances such as toasters and irons, and for parts operating at high temperatures in jet engines and rockets.

Precision Metalsmiths, Inc., Cleveland, announces the development of 11 new alloys so far this year, augmenting the 80 alloys previously cast by the firm. In addition, research is now going on in the development of 13 other new alloys. Of the 11 newly-developed alloys, three have specialized magnetic properties, four are of the nickel-iron classification, one is of the non-variant type and undergoes no changes at varying temperatures, and four were developed to meet specific customer requirements. Another research and development program seeks closer dimensional properties in castings and consists of production tests involving temperatures and resulting behavior of wax used for patterns, variables of the investment process and related conditions. In progress for the past seven months, the project will be completed sometime early in 1951.

National Carbon Div., Union Carbide & Carbon Corp., New York, is considering a major expansion of its electrode plant at Columbia, Tenn., pending formal approval of an arrangement with the Tennessee Valley Authority for supply of power. This proposed $5 million expansion is being undertaken to meet growing demand for large graphite electrodes in the metallurgical and steel industries. Division officials state. The plant will have the most modern and efficient production facilities and will produce graphite electrodes in sizes to 40 in. diameter by 110 in. long and weighing about 7,000 lb each.

Lincoln Smelting & Refining Co., a newly organized firm, has leased a building in Bedford Park, Ill., a suburb of Chicago, for the resmelting and reclaiming of non-ferrous metals.

Tennessee Products & Chemical Corp., Nashville, Tenn., producers of coke and pig iron, has underwritten America's newest cup race for midget planes. The new competition is known as the Tennessee Products Gold Cup Race, with purses totalling $5,000, and was first held at the National Pilots' Air Meet July 14-16 in Chattanooga, Tenn.

Electric Steel Foundry Co., Portland, Ore., has moved its Spokane, Wash., branch from 121 Monroe St. to a new office and warehouse building at N. 1327 Washington St. N. J. Vanelli, the company's Inland Empire territory representative, will take over management of the Spokane office from E. V. Wickey, who will be able to devote his full time to field sales work in the area. The new Spokane quarters are of modern steel and concrete construction and offer ample warehouse facilities for stocks of pipe fittings, logging and other construction equipment.

Admiral Die Castings Co. is constructing a 21,000 sq ft, one-story factory at 310 West 83rd St., Chicago, for the production of aluminum castings.

Kirk & Blum Mfg. Co., Cincinnati, has acquired the entire plant and property of the **Cincinnati Planer Co.,** 3120 Forrer St., Oakley, a suburb of Cincinnati. The plant will be occupied by Kirk & Blum about the end of the year and will house the consolidated manufacturing and warehousing facilities of Kirk & Blum, now scattered in five units throughout Cincinnati. All under one roof, the new plant has over 100,000 sq ft of one-story manufacturing and storage space, fronted by an air-conditioned, two-story office and engineering building. The plant is completely equipped with jib and bridge cranes and is served by arterial highways and its own railway spur.

Pettibone Mulliken Corp., Chicago, announces the acquisition of **Hammermills, Inc.,** St. Louis, as a wholly-owned subsidiary. Hammermills, Inc., manufactures the Bulldog line of hammermills for mining iron ore, coal, copper, limestone, gypsum, etc., and also used in cement and chemical, brick and tile plants. President C. M. Binder and Vice-President and Chief Engineer T. A. Oberhellmann of Hammermills will continue in the same capacity under Pettibone Mulliken ownership. Headquarters for Hammermills, Inc., have been moved from St. Louis to the factory of Pettibone Mulliken Corp. at 4700 W. Division St., Chicago.

Catalin Corp. of America, New York and New Jersey, announces that its new plant at Calumet City, Ill., is now in operation for the production of core baking resins, urea formaldehyde, urea, phenolic, melamine and resorcinol resin formulations for gluing, laminating and impregnating woods.

Harbison-Walker Refractories Co., Pittsburgh, has started construction of a new Cleveland office and refractories warehouse at 1986 West 3rd St., a half-mile from Cleveland's public square. The new warehouse will house the equivalent of 100,000 nine-inch refractory bricks.

Award Eye Safety Certificates

EIGHT COMPANIES were recently awarded certificates of appreciation from the National Society for the Prevention of Blindness for their work in promoting the Wise Owl Club of America, an eye safety organization for industrial workers.

Among organizations cited on May 24 in New York City as part of the Society's "Mobilization to Prevent Blindness" program were American Car & Foundry Co., Electro Metallurgical Div., Union Carbide & Carbon Corp., Reynolds Metals Co., and General Electric Co.

Publish Illinois Foundry Reference Work

ILLINOIS FOUNDRIES, their assets, operations and future development, are the subjects of a 148-page bulletin, "The Foundry Industry in Illinois," by Harry Czyzewski and Burton C. Person, Bureau of Economic and Business Research, University of Illinois, Urbana.

Outlined is the degree to which Illinois foundries have made use of developments in mechanization, captive vs. jobbing organization, geographical and industrial distribution of markets and technical control and development work. Also discussed are castings markets and the need for trained foundry personnel in the area.

Film Shows Conveyors' Role in Industry

MECHANICAL handling methods and their role in reducing industrial production costs is the subject of a 24-minute sound film, *"Yours to Command,"* recently released by the Conveyor Equipment Manufacturers Association. Modern applications in more than a score of industries are shown and the expanding markets and job opportunities that result from systematic application of conveying equipment are dramatized in the commentary and in pictorial color charts.

Copies of the film are available from Conveyor Equipment Manufacturers Ass'n., 1129 Vermont, Washington, D. C.

Welding of Castings Subject of AWS Booklet

NEWLY PUBLISHED by the American Welding Society, *"Recommended Practices for Salvaging Automotive Gray Iron Castings by Welding,"* a 19-page booklet, provides information on best methods of repairing specific types of defects.

Information is given on oxy-acetylene and shielded metal arc welding with and without pre-heat and stress relief, braze-welding, brazing, soft soldering, metallizing and use of mechanical methods.

Copies may be obtained at $.50 each from the American Welding Society, 33 West 39th St., New York 18, N. Y.

GLOSSARY

(Continued from Page 83)

thick sections. Bombardment by neutrons can make any metal radioactive and small concentrations of such metals are used as "tracers" in the study of diffusion and other phenomena.

radiography—A nondestructive method of internal examination in which metal objects are exposed to a beam of x-ray or gamma radiation. Differences in thickness, density or absorption, caused by internal defects or inclusions, are apparent in the shadow image either on a fluorescent screen or on photographic film placed behind the object.

radium — A radioactive element with the chemical symbol Ra; radium and its salts are used in gamma ray radiography because of their radioactivity.

ram—To pack the sand in a mold.

ramaway—A casting defect resulting from a section of the mold being forced away from the pattern by ramming sand after it has conformed to the pattern contour.

rammer, air — A pneumatic tool used in packing sand around a pattern.

rammer, hand — A wooden tool with a round mallet-shaped head at one end and a wedge-shaped head at the other, used in packing sand around the pattern in making a mold.

ramming—The operation of packing sand around a pattern in a flask to form a mold.

ramoff — A casting defect resulting from a section of the mold being forced away from the pattern by ramming sand after it has conformed to the pattern contour.

rapping—Knocking or jarring the pattern to loosen it from the sand in the mold before withdrawing the pattern.

rapping plate—A metal plate attached to a pattern to prevent injury to the pattern and assist in loosening it from the sand.

rat — A lump on the surface of a casting caused by a portion of the mold face sticking to the pattern.

rat-tail — A minor buckle, occurring as a small irregular line or lines.

rebonded sands—Used or reclaimed molding sand restored to usable condition by the addition of new bonding material.

reclamation, sand—See SAND RECLAMATION.

recuperator — Equipment for recovering heat from hot, spent gases and using it for the preheating of incoming fuel or air; is a continuous operation, in which the incoming materials pass through pipes surrounded by a chamber through which the outgoing gases pass.

red shortness—Brittleness in steel when it is red hot.

refractory (noun) — A heat-resistant material, usually nonmetallic, used for furnace linings and such.

refractory (adj.)—The quality of resisting heat.

refractory clay—A clay which fuses at cone 25 (1590 C, 2894 F) or higher.

retained strength—That tenacity (compressive, shear, tensile or transverse) attained by a sand mixture after being subjected to a cycle or cycles of heating and cooling which approximates foundry practice.

reverberatory furnace—A furnace having a vaulted ceiling that deflects the flame and heat toward the hearth or the surface of the charge to be melted.

riddle — Screen or sieve operated manually or by power, for removing large particles of sand or foreign material from foundry sand.

riddled sand — Sand that has been passed through a riddle or screen.

riser—A reservoir of excess molten metal at the top of the heaviest section or sections of a casting, designed to supply metal in compensation for shrinkage that cannot be fed properly from gate.

Rockwell hardness—The hardness value of a metal determined by measuring the depth of penetration of a 1/16-in. steel ball ("B" scale) or a diamond point ("C" scale) using a specified applied load.

rolling over — The operation of reversing the position of a flask in which the drag part of the pattern has been rammed with the parting surface downward.

rollover board—A wood or metal plate on which the pattern is laid top face downward for ramming the drag half mold, the plate and half mold being turned over together before the joint is made.

rollover machine—A molding machine by which the flask is rolled over before the pattern is drawn from the mold.

rosette—Rounded configuration of eutectiferous constituents in the microstructure of an alloy, indicative of eutectic melting during heat treatment.

rough surface—Surface of a casting lacking the required degree of smoothness.

(Continued on Next Page)

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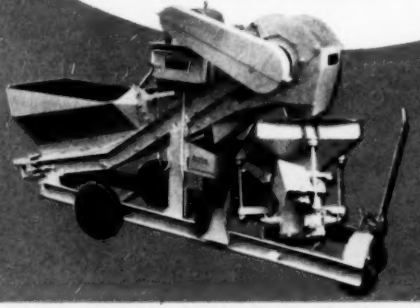

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GLOSSARY

(Continued from Preceding Page)

runner—A channel through which molten metal or slag is passed from one receptacle to another; in a casting mold, the portion of the gate assembly that connects the downgate or sprue with the casting.

runner box—Device for distributing molten metal around a mold by dividing it into several streams.

runner riser—A channel in the horizontal or vertical plane which permits flow of molten metal around to the gate or gates entering the end and also acts as a reservoir to feed the casting.

runout—A casting defect wherein a casting lacks completeness due to molten metal draining or leaking out of some part of the mold cavity during pouring; escape of molten metal from a furnace, mold or melting crucible.

S

sag—A decrease in metal section in a casting due to sagging of the cope or core.

sand—Specifically a loose material consisting of small but easily distinguishable grains, often of quartz, resulting from disintegration of rock; when used as a molding material, the grains should pass a No. 6 and be retained on a No. 270 sieve. Sometimes used to designate a sand-clay mixture appearing naturally in proper proportions for molding.

sand, bank—Sand from a bank or pit.

sand blast—Sand driven by a blast of compressed air (or stream); used to clean castings; to cut, polish or decorate glass or other hard substances; for cleaning building fronts, etc.

sand burning—Formation of a hard surface on a sand casting by the reactions between the sand of the mold and the hot metal.

sand castings—Metal castings produced in sand molds.

sand control—Procedure whereby various properties of foundry sand, such as fineness, permeability, green strength and moisture content, are adjusted to obtain castings free from blows, scabs, veins and similar defects.

sand cutting—Preparing sand for molding, either by hand or by a machine, the operation also aerating the sand.

sand holes—Cavities of irregular shape and size the inner surfaces of which plainly show the imprint of a granular material.

sand reclamation—Processing of used foundry sand, normally wasted, by thermal or hydraulic methods, so that it may be used in place of new sand without substantially changing current foundry sand practice.

sand slinger—Molding machine which throws sand into a flask or corebox, by centrifugal action.

sand tempering—Adding sufficient moisture to sand to make it satisfactory for molding purposes.

scab—A defect on the surface of a casting caused by eruption of gas from the mold face, or by uneven mold surfaces; or occurring where the skin from a blowhole has partly burned away and is not welded.

scarfing—Cutting off surface areas such as

gates and risers from castings by using a gas torch.

scrap – Material unsuitable for direct use but usable for reprocessing.

scrap (metal) – Metal to be remelted, includes sprues, gates, risers, defective castings, and scrapped machinery.

screen – A perforated metal screen placed between the gate and the runner of a casting mold for the purpose of separating entrapped oxides or gases during the pouring.

sea coal – Finely ground soft coal, mixed with molding sand.

seam–A surface defect on a casting related to but of lesser degree than a coldshut.

season cracking – Stress-corrosion cracking occurring in copper-base alloys that involves only residual stresses and specific corrosive agents (usually ammonia or compounds of ammonia).

secondary hardening – Tempering certain alloy steels at certain temperatures so that a hardness is obtained greater than that resulting from the tempering of the same steel at some lower temperature for the same time.

sectional core–A core made in two or more parts and pasted or wired together.

segregation–In a casting, concentration of alloying elements at specific regions, usually as a result of the primary crystallization of one phase with the subsequent concentration of other element in the remaining liquid. *Microsegregation* refers to *normal segregation* on a microscopic scale whereby material richer in alloying element freezes in successive layers on the dendrites (*coring*) and in the *constituent network*. *Macrosegregation* refers to gross differences in concentration (for example, from one area of a casting to another) which may be *normal inverse* or *gravity segregation*.

selective heating–A process by which only certain portions of casting are heated, in a way that will produce desired properties after cooling.

selective quenching – A process by which only certain portions of a casting are quenched.

self-hardening steel – A steel containing sufficient carbon or alloying element, or both, to form martensite either through air hardening or, as in welding and induction hardening, through rapid removal of heat from a locally heated portion by conduction into the surrounding cold metal. See AIR-HARDENING STEEL.

semi-steel–A misnomer–the term refers to a gray iron the charge for which consisted of a high percentage of steel scrap.

semikilled steel–Steel incompletely deoxidized, to permit evolution of sufficient carbon monoxide to offset solidification shrinkage.

shakeout–The operation of removing castings from the mold.

shank – The handle attached to a small ladle.

sharp sand – A sand that is substantially free of bond. The term has no reference to the grain shape.

shear strength–Maximum shear stress which a sand mixture is capable of developing.

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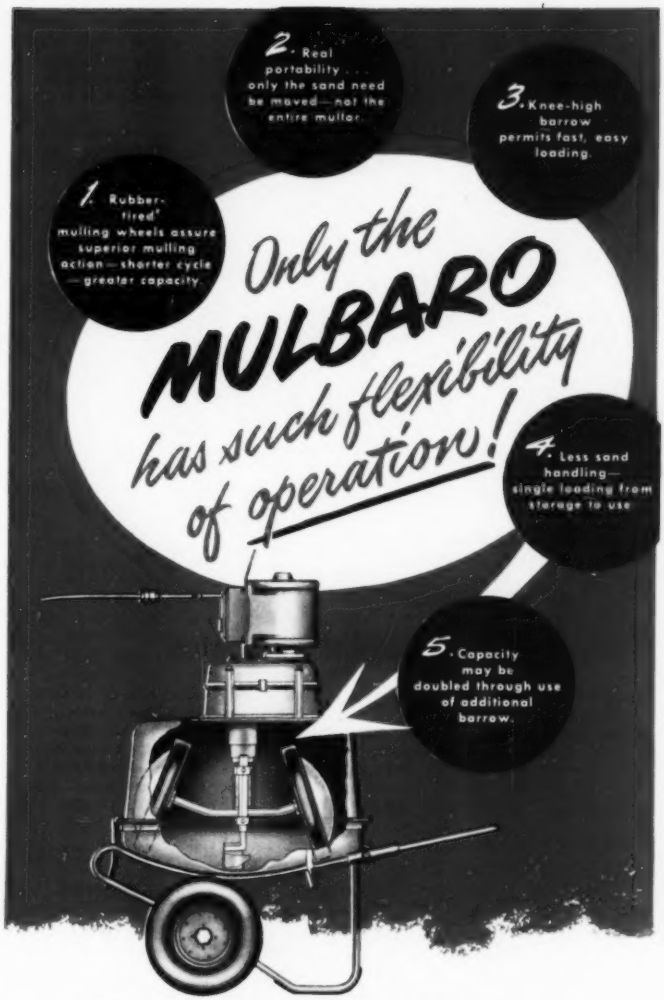
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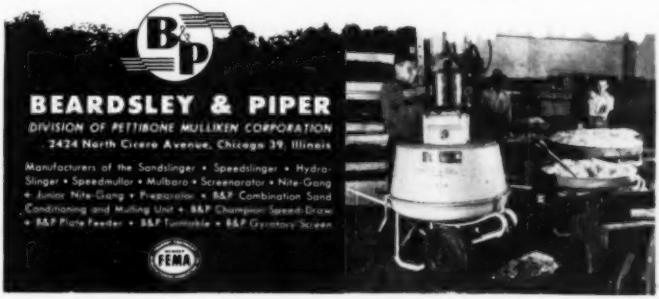
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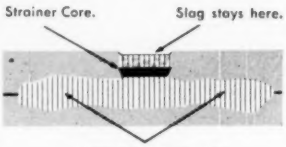

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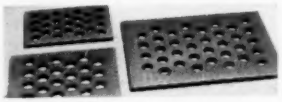

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GLOSSARY

(Continued from Preceding Page)

shielded-arc welding—Electric-arc welding in which the metal is protected from the atmosphere. An inert gaseous atmosphere may be used, or flux-coated electrodes.

shift—A casting defect caused by mismatch of cope and drag.

shortness—Brittleness in metal.

shrinkage cavity—A void left in cast metals as a result of solidification shrinkage and the progressive freezing of metal toward the center.

shrinkage, patternmaker's — Shrinkage allowance on patterns to compensate for contraction as the solidified casting cools in the mold from the freezing temperature of the metal to room temperature.

shrinkage cracks — Cracks that form in metal as a result of the pulling apart of grains by thermal contraction before complete solidification.

silicious clay — A clay containing a high percentage of silica.

silt — Very fine sand particles that pass a No. 270-mesh sieve, but which are not plastic nor sticky when wet.

sintering point — That temperature at which the molding material begins to adhere to the casting, or in a test when the sand coheres to a platinum ribbon under controlled conditions.

sizing — Primary coating of very thin glue given to end grain wood to seal the pores.

skeleton pattern—A framework representing the interior and exterior form and the metal thickness of the required casting.

skimgate—See SCREEN.

skimmer — A tool for removing scum and dross from molten metal.

skimming — Holding back from a casting the dirt, slag, or skim in the molten metal before or during pouring.

skin—A thin surface layer that is different from the main mass of a metal object, in composition, structure or other characteristics.

skin-drying — Drying of the surface of the mold by direct application of heat.

skull — A film of metal or dross remaining in a pouring vessel after the metal has been poured.

slab core—Flat, plain core.

slag — A nonmetallic covering which forms on the molten metal as a result of the combining of impurities contained in the original charge, some ash from the fuel, and any silica and clay eroded from the refractory lining. It is skimmed off prior to tapping of the heat.

slag hole — An opening in the back of a cupola through which the slag is drawn.

slip jacket — A frame to place around a snap-flask mold after the flask is removed.

slick, slicker, smoother — A tool used for mending and smoothing the surfaces of a mold.

sludge ladle — A hemispherical steel ladle used to remove sludge from the bottom of a melting pot.

slurry — The mixture used to fill in the joints of a core.

slush casting—A casting made from an al-

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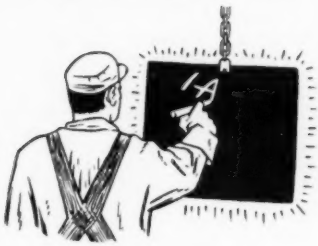

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loy that has a low melting point and freezes within a wide range of temperature. The metal is poured into the mold, and brought into contact with all surfaces so as to form an inner shell of frozen metal; then the excess metal is poured out. Castings that consist of completely enclosed shells may be made by using a definite quantity of metal and a closed mold.

snap flask — A flask used for small work, differing from the ordinary flask in that it has hinges and latches or some other device so that it can be opened or held together as desired.

soaking—Prolonged heating of a metal at a selected temperature.

soda ash—Commercial sodium carbonate.

soldiers — Thin pieces of wood used to strengthen a body of sand or to hold it in place.

solid contraction — Shrinkage occurring in metal in the solid state as it cools from the solidifying temperature to room temperature.

sulphur dome—An inverted container holding a high concentration of sulphur dioxide; used over a pot of molten magnesium in connection with die casting of magnesium.

superheating — A process of refining the grains in certain magnesium alloy castings by heating the molten metal between 1500 and 1700 F.

superimposed core—A core placed upon and rammed up with a pattern.

suspended core — A core having the core seat so formed that it may be suspended from above the mold.

swab — A sponge or piece of waste, hemp, or other material used in dampening sand around a pattern before withdrawing it. Sometimes used in blacking molds which might be broken by a brush.

sweep — A board having the profile of the desired mold, which when revolved around a stake or spindle, produces that mold.

sweep-work—Molds made of pieces of patterns and sweeps instead of patterns.

swell—A casting defect consisting of an increase in metal section due to the displacement of sand by metal pressure.

synthetic molding sand — Any sand compounded from selected individual materials which, when mixed together, produce a mixture of the proper physical properties from which to make foundry molds.

T

tally mark — A mark or combination of marks indicating the correct location of a loose piece of a pattern or core box.

tap hole — Opening in the cupola and furnace breast through which the molten metal is tapped.

tap hole plug stick—A wooden stick with a ball of clay on the end, used to close a tap hole.

tap-out bar — A bar used for opening furnace tap holes.

tapping—Reopening the aperture at the spout to permit the molten metal to run from the furnace.

tellurium—A nonmetallic element which, when added to molten iron, acts as a strong carbide stabilizer.

temper (verb)—Mixing sand with sufficient

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Transverse Core Tester Rapidly determines transverse strength of sand cores.

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Sand Mixer For thorough preparation of sample core-sand mixtures.

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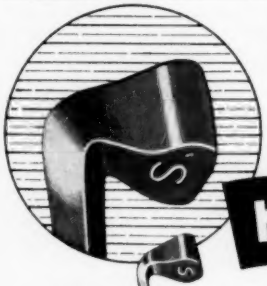

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water or other liquid to develop optimum molding properties.

temper (noun)—The moisture content of a sand at which any certain maximum physical test value is obtained, i.e., temper with respect to green compressive strength, permeability, retained compressive strength, etc.

temper carbon—The free or graphitic carbon that precipitates from solution, usually in the form of rounded or equiaxed nodules in the structure, during the graphitizing or malleablizing of white cast iron.

temper water — Water added to molding sand to give proper molding consistency.

tempering—A process of reheating quench-hardened or normalized steel to a temperature below the transformation range, and then cooling at any desired rate.

tempering sand — Dampening and cutting over or otherwise mixing sand to produce uniform distribution of moisture.

templet — Thin piece of material with the edge contour made in reverse to the surface to be formed or checked.

temporary pattern—A pattern used to produce one or two castings and made as cheaply as the case will permit.

tensile strength — Maximum tensile stress which any material is capable of developing.

ternary alloy—An alloy that contains three principal elements.

test bar — Standard specimen designed to permit determination of mechanical properties of the metal from which it was poured.

thermal contraction — The decrease in a linear dimension of a sand mixture accompanying a change of temperature.

thermal expansion—The increase in a linear dimension of sand mixture accompanying a change of temperature.

thermal stresses — Stresses in metal, resulting from nonuniform distribution of temperature.

thermit reactions—Exothermic, self-propagating processes in which finely divided aluminum powder is used to reduce metal oxides to free metals by direct oxidation of aluminum to aluminum oxide, with accompanying reduction of the less stable metal oxide.

thermocouple — A device for measuring temperatures by the use of two dissimilar metals in contact; the junction of these metals gives rise to a measurable electrical potential with changes in temperature.

thixotropy—In sand testing, the proportion of the volumes of liquid and solid matters which is required, one minute after shaking, for the suspension to just flow out of an 8 mm diam. test tube, when the test tube is changed from a vertical to a horizontal position.

tie piece — Bar or rod-shaped piece built into a pattern and made a part of the casting to prevent distortion caused by uneven contraction between separated members.

tilting furnace—A melting furnace that can be tilted to pour out the molten metal.

tin sweat — Beads of tin-rich low-melting phase that are found on the surface of bronze castings when the molten metal contains hydrogen.

top board—A wood board which is used on the cope half of the mold to permit squeezing the mold.

transfer ladle — A ladle that may be supported on a monorail or carried in a shank and used to transfer metal from melting furnace to holding furnace.

transformation range or transformation temperature range — The temperature interval within which austenite forms while ferrous alloys are being heated; also the temperature interval within which austenite disappears while ferrous alloys are being cooled. The two ranges are distinct, sometimes overlapping but never coinciding. The limiting temperatures of the ranges depend on the composition of the alloy and on the rate of change of temperature, particularly during cooling.

transverse strength—The transverse modulus of rupture of a sand mixture.

trimming — Removing fins and gates from hard iron castings with hand hammers.

troostite—Tempered martensite that etches rapidly, usually appears dark, and is not resolved by the microscope.

trowel — A tool for slicking, patching, and finishing a mold.

tucking — Pressing sand with the fingers under flask bars, around gaggers, and other places where the rammer does not give the desired density.

tumbling—Cleaning castings by rotation in a cylinder in the presence of cleaning materials.

tumbling barrels—Rotating barrels in which castings are cleaned, also called rolling barrels and rattlers.

tuyere—An opening in the cupola through which the blast is forced.

U

ultimate strength—See TENSILE STRENGTH.

undercut—Part of a mold requiring a drawback. See DRAWBACK.

upset (frame)—Frame to increase the depth of a flask.

V

vacuum refining — Melting in a vacuum, usually by electrical induction, to remove gaseous metal contaminants.

vent — A small opening in a mold to facilitate escape of gases when pouring.

vent wire — A wire used to make vents or small holes in the mold to allow gas to escape.

venting — The perforation with a venting needle of the sand over and around a mold cavity to assist in the escape of the gases.

venting quality—See PERMEABILITY.

vibrator—A device, operated by compressed air or electricity, for loosening and withdrawing patterns from a mold.

virgin metal—Metal obtained directly from the ore.

vitrification point—The temperature upon heating at which clays reach the condition of maximum density and shrinkage.

W

warm strength (of a core)—Strength that a core possesses at temperatures in the range of 150 to 300 F.

warpage—Deformation other than contraction that develops in a casting between solidification and room temperature; also, distortion of a board through the absorption or expulsion of moisture.

washes—Defects in a casting resulting from erosion of the sand by metal flowing over the mold or cored surface.

wax — Class of substances of plant, animal or mineral origin, insoluble in water, partly soluble in alcohol, ether, etc., and miscible in all proportions with oils and fats. They consist of esters, free fatty acids, free alcohols, and higher hydrocarbons. Common waxes are beeswax, paraffin wax, ozokerite, ceresin, carnauba. Mixtures of those are formed into rods and sheets and used for forming vents in cores and molds, etc.

weep hole — A hole placed in a casting to allow drainage of moisture.

weak sand — Sand lacking in the proper amount of clay or bond.

web — A plate or thin member lying between heavier members.

welding—A process used to join metals by the application of heat. Fusion welding, which includes gas, arc, and resistance welding, requires that the parent metals be melted. This distinguishes fusion welding from brazing. In pressure welding joining is accomplished by the use of heat and pressure without melting. The parts that are being welded are pressed together and heated simultaneously, so that recrystallization occurs across the interface.

welding stress—Stress resulting from localized heating and cooling of metal during welding.

whirl gate—A gate or sprue arranged to introduce metal into a mold tangentially, thereby imparting a swirling motion.

white cast iron — Cast iron in which substantially all the carbon is present in the form of iron carbide. Such a material has a white fracture.

wind-box — The chamber surrounding a cupola through which air is conducted to the tuyeres.

winding strips—Parallel straightedges used in testing large working faces.

Wood's metal — A low melting alloy containing 25 per cent lead, 12.5 per cent tin, 50 per cent bismuth, and 12.5 per cent cadmium; melting temperature is 154.4 F.

workable moisture — That range of moisture content within which the sand fills, rams, draws, and dries to a satisfactory mold, and within which the sand does not dry out too fast to mold and patch.

working edge — Edge surface of a piece of material that has been planed straight and square with the working face.

working face—Surface of a piece of material that has been planed true and that is to be used as a basis for the dressing of all other surfaces.

X

x-ray — Form of radiant energy with extremely short wave length which has the ability to penetrate materials that absorb or reflect ordinary light.

Y

yield strength — The stress at which a material exhibits a specified limiting permanent stress.

yield point—The load per unit of original cross section at which increase in deformation occurs without increase in load.

Z

zinc — Predominant alloying element in brass, having the chemical symbol, *Zn*.

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Cracking Resistance
Stickiness
Moisture

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Air Set Strength
Dry Strength

4 BETTER CORE CONDITION

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Core Strength
Core Deflection
Moisture Absorption
Gas Pressure

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LITERATURE

(Continued from Page 80)

Refractory Products

SP114—Six-page folder contains complete data (softening points, containers, air or heat set, lb per 1000 brick, wt/cu ft, acid or neutral, and uses) of cements and mortars, plastics, castables, coatings, fire brick, silica brick, acid proof brick and insulating fire brick. Included are tables on quantities of fire brick required per sq ft, mortar or cement required per 1000 new fire brick, table of 9-in. wedge brick, table of 9-in. arch brick, table of 9-in. circle brick, method of estimating temperatures, tables of caloric values of fuels, and means of estimating amount of Furnaseal and Super Plastic, Hearthmix and Bafflemix and Furnascote and Suprezist Mix required for various areas. *Laclede-Christy Co.*

Electric Hoists

SP115—Complete, improved line of electric roller-chain hoists is described in eight-page illustrated booklet. Shown are such features as: one-hand control, double braking; precision cut phosphor bronze worm gear; low headroom, alloy steel roller chain; positive acting upper and lower limit switches, interchangeable parts. Complete specifications of models ranging from 500 to 4000 lb capacity. Also cataloged I-beam trolleys, chain containers and other accessories for hoists. *Whiting Corporation.*

Molding Machines

SP116—Illustrated 16-page booklet shows representative molding machine installations in several U. S. foundries. Photographs show machines actually at work. Pertinent information on good housekeeping practices, their capacities, types of castings produced, safety measures, melting equipment used and other essential data on these foundries are included. *Herman Pneumatic Machine Co.*

Electrostatic Precipitation

SP117—Illustrated with photographs and diagrams, 16-page bulletin describes how electronic precipitation works, gives case histories of typical installations, and describes various methods of electrostatic precipitation and equipment used for each. Units can collect 1/100,000 in. diameter cigarette smoke particles, or deposit ¼ in. fibers on adhesive cloth, as example of unit's flexibility. *General Electric Co.*

Cleaning, Finishing Machinery

SP118—Illustrated 38-page catalog describes complete line of metal cleaning and finishing machinery. Opening with brief discussion of principles of metal cleaning, catalog lists such equipment as conveyor, monorail, drum, turntable, strip, cabinet and agitating type cleaning machines, phosphatizing machines, paint spray booths, drying ovens, special equipment and accessories. *Cincinnati Cleaning and Finishing Machinery Co.*

Sand Core Dryer

SP119—Designed to cut core drying time from hours to minutes is the Foundromatic sand core dryer described in newly-released illustrated folder. Consisting of an oven and dielectric heater, this unit was featured at the 1950 A.F.S. Foundry

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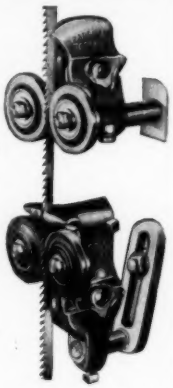

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Congress & Show, Cleveland. Use of the dryer is explained and specifications concerning the equipment are given. *Allis-Chalmers Mfg. Co.*

Foundry Ventilation

SP120—Two booklets, one dealing with dust, fume and smoke hoods and the other with an overall foundry ventilation plan are offered gratis. Bulletin No. 450 describes functions, advantages and applications of the complete line of Uni-Flo hoods for foundry shakeouts of all sizes, pouring stations and mold conveyors. Four pages are devoted to diagrams and specifications for determining individual installation requirements. Bulletin No. 550 explains a new plan for achieving foundry efficiency and economy through balance of all foundry air. Plan "bvb" takes into consideration all foundry air, supply air, exhaust air, building leakage and heat loss. This balancing of air eliminates negative pressures and secondary air flow patterns, thus contributing to more efficient operation of foundry equipment. *Claude B. Schneible Co.*

Industrial Photography

SP121—Applications of photography to industry and business are summarized in a 16-page booklet titled "Functional Photography in Industry." Text, prepared in non-technical language, sums up these methods and their results. Illustrations depict their use in research, production, quality control, training, advertising and sales. Simple form is provided for requesting more detailed information on any processes summarized. *Industrial Photographic Div., Eastman Kodak Co.*

Portable Industrial Vacuums

SP122—Described in two newly-published illustrated folders are (1) the Hoffco-Vac super duty portable cleaning unit, an all-purpose portable industrial vacuum cleaner featuring ability to operate continuously over 24-hour periods under severe conditions in areas that would otherwise require a permanently-piped stationary vacuum cleaning system; and (2) the Hoffco-Vac No. 30 offers the same advantages as the above unit in a smaller, 3-hp machine which is easily maneuvered through narrow or congested areas. Applications, specifications, operating data are completely covered for each machine. *United States Hoffman Machinery Corp.*

Power Wheel Buckets

SP123—Power wheel buckets for rehandling of foundry sands, coke, limestone, etc., are described in a four-page folder. Cited by manufacturer are fast closing of jaws, long life, speed, capacity, rope economy, low upkeep and compact dimensions. Complete specifications for all types are given. *George Haiss Mfg. Co., Inc., Division of Pettibone Mulliken Corp.*

Magnetic Separator

SP124—Dings non-electric, Alnico Perma-Drum magnetic separator is described in an eight-page catalog. Available in three models, design features of separator are covered, plus information on correct selection of separators for given applications and data on capacities and dimensions. *Dings Magnetic Separator Co.*

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A. F. S. Employment Service

To contact "Help Wanted" or "Position Wanted" advertisers, write to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, designating item number and issue of AMERICAN FOUNDRYMAN in which advertisement is published.

In replying to "Help Wanted" advertisements, please furnish resumé of experience, education and other pertinent qualifications.

HELP WANTED

HW531—Core Room Foreman: Large Southern gray iron foundry desires experienced man capable of supervising production and assembly of small to medium sized cores on highly repetitive work. Must be able to teach and coordinate making of cores on benches and blow machines. In replying please state age, experience, and salary expected.

HW532—Pattern Shop Supervisor: Capable of supervising design, rigging, and maintenance of metal pattern and core box equipment in large Southern production gray iron foundry. Please give references and full details of experience.

HW535—Time Study & Methods Engineer: With steel foundry experience, wanted for permanent position in vicinity of Cleveland, Ohio. Good opportunity with well established company. Write stating experience, qualifications, and expected salary to start.

HW536—Sand Plant Manager: Want man with foundry experience to operate and manage sand plant located in Middle West.

HW537—Sales Engineer: National organization is seeking services of experienced, well-qualified sales engineer, between 35 and 40 years of age, who has a thorough knowledge of foundries and foundry practice, preferably one who has had extensive contacts with foundries in the Midwest. Salary will be commensurate with ability. All replies held in strict confidence.

HW539—Permanent Mold Superintendent: Man capable of running permanent and semi-permanent mold shop from estimate through finished casting. Must be able to design molds. Metropolitan New Jersey area. State all qualifications in reply.

HW541—Core Room Foreman: Medium size Middle West gray iron foundry specializing in cylinder heads, blocks, and manifolds. Fine opportunity for man able to take complete charge of core room. We are a growing organization and can reward ability to produce with further advancement.

HW542—Research Metallurgist: Experience in melting and casting of metals desired. Familiarity with ferrous and non-ferrous alloys required. Experience in following important: vacuum melting and casting, melting and casting of titanium, gases dissolved in molten metals, and effect of vibration on solidification. Opportunity to do publishable research in well-equipped laboratory. Minimum education B.S. from well-rated university; doctor's degree desirable. High-grade experience may be substituted for advanced degree. Minimum working experience four years progressive professional scientific employment including at least one year important and responsible work. Civil Service position.

HW543—Assistant Foundry Superintendent: with gray iron foundry experience, wanted for permanent position in mechanized foundry producing automotive castings, located in Middle West. Excellent opportunity with large reputable manufacturing concern. Write, stating experience, qualifications and expected salary.

HW544—General Manager for well-established brass foundry. Capable of estimating, rigging, handling labor relations, sales and general administration. Substantial salary with incentive. Located in Chicago.

HW545—Core Room Foreman: Ohio manufacturer of medium and large diesel engine gray iron castings, with some miscellaneous jobbing work, needs an experienced core room foreman.

HW546—Foundry Superintendent for gray iron foundry. Must have thorough and proven experience in cylinder block and cylinder head jobbing work. Must know all technical details of foundry and core room operation. Excellent opportunity. Give experience, age, marital status, expected salary, etc.

HW547—Industrial Resins Salesman. Requirements are degree in chemical or metallurgical engineering with several years foundry experience, particularly with core oils and resin binders. Sales background helpful but not essential. Prefer man 30 years of age or younger. Give complete background in letter addressed to R. F. McCoole, Monsanto Chemical Co., 1700 S. Second St., St. Louis, Mo.

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PW147—Manufacturer's Agent: Want quality casting lines on commission basis for state of Michigan. Have metallurgical and foundry production experience.

PW148—Metallurgical Engineer: Two years foundry research with large corporation. B.S. in metallurgical engineering. Desire position with progressive foundry on East Coast. Age 25. Complete details of qualifications on request.

PW149—Chemical Metallurgist: Fifteen years' experience in secondary brass smelting. Can design and build furnace and make quality ingot.

PW150—Superintendent: Six years' experience in Aluminum and Magnesium Permanent Mold Foundries. Engineer of Metallurgy degree. Thoroughly capable of handling production and technical aspects of foundry management. Age 32. Available 30 days.

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Fig. 117—Bench-type Core Blowing Machine

Fig. 190—High-frequency Dielectric Core Baking Oven

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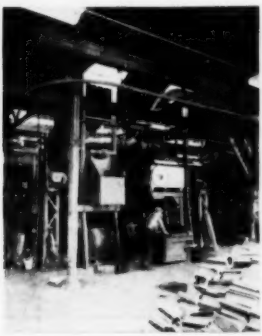

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